

# A review on ethnomedicinal use, nutritional value, phytochemistry and pharmacological characteristics of *Solanum incanum* L. An important medicinal plant

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**Abstract:** Pharmacological properties of medicinal plants and various natural products of plant origin lie in the chemical constituents they contain. Thus, in most cases, the principal aim of phytochemical analysis of plants and natural products is to detect, isolate, characterize and identify these chemical substances. This paper reviews scientific works carried out on the ethnomedicinal uses, phytochemistry and pharmacological properties of *Solanum incanum* L. It was understood that various parts of this plant were traditionally used to treat various types of ailments. A study of literature reveals some notable pharmacological activities of the plant such as antimicrobial activity, antimalarial activity, the antinociceptive effects, antioxidative property, immunological effects and many more medicinal values. Various phytochemical analyses carried out on the plant also revealed the presence of vast array of phytochemicals which were medicinally important. There for this paper was reviewed and provided some of the up to date scientific works carried out on this important traditional medicinal plant.

**Key words:** Ethnomedicinal use, Medicinal plant, Nutritional value, Pharmacological property, Phytochemical, *Solanum incunum* L.

## 1. Introduction

Traditional medicine (TM) is the sum total of all the knowledge, beliefs and practices that are used in prevention, diagnosis and elimination of physical, mental and social imbalance that exclusively rely on practical experiences and observation [1]. The most common TM is the use of medicinal plants. Medicinal plant in the context of TM can be defined as any plant which contains substance that can be used for therapeutic purpose or which is a precursor for synthesis of useful drugs [2]. Syed and Rajeev [3] also defined medicinal plant as any plant in which one or more of its organs containing substances that can be used for therapeutic properties. There is a proportional increase in demand for herbal products both locally and internationally [4]. The demand is caused by population increase, poverty, increasing awareness of herbal products, high cost of modern medicine and limited access to trained doctors. Medicinal plants are cheaper and more accessible to most of the population in the world. Thus, there is need to encourage the use of medicinal plants as potential sources of new drugs [5]. According to the world health organization greater than 80% of the total world's population depends on the TM in order to satisfy their primary health care needs [6]. The organization estimates about 35, 000 – 70,000 species of plants are used for medicinal purposes around the world, of which some 5000 have been submitted to biomedical study [7]. World health organization also observed that the majority of the populations in the developing countries are still relying on herbal medicine to meet their health need [8].

Antibiotics have always played a major role in the treatment of many diseases. However, due to the acquired resistance of pathogens against certain antibiotic, drug resistance to human pathogenic bacteria has increased all over the world [9]. This has created immense clinical problem in the treatment of the infectious disease. Therefore, limited numbers of drugs are available for their treatment and emerging resistance which permanently encourage the search for alternatives with low cost and low toxicity [10]. Many efforts have been made to discover new antimicrobial compounds from various species of medicinal plants and the results derived from these scientific studies have aided in the validation of traditional uses of these plants [11]. Screening of such compounds from plants may result in the discovery of novel effective compounds against pathogenic microorganisms that can either inhibit the growth of pathogens or kill them and have no or least toxicity to host cells [12]. These effects of the plants result from the combinations of secondary products present in them. In plants, these compounds are mostly secondary metabolites such as alkaloids, steroids, tannins, and phenol compounds, which are synthesized and deposited in specific parts or in all parts of the plant [13]. Large number of medicinal plants has been evaluated for their biological activity in order to rationalize their use in TM [14]. Among those, *Solanum incanum* L. is the known medicinal plant used traditionally for the treatment of different infections [15]. The plants are used in tropical Africa, including Ethiopia, as traditional health care for treatment of diseases such as sore throat, stomach-ache, malaria, common cold, hypertention, diabetics, hea-dache, painful menstruation, liver pain and pain caused by onchocerciasis, pneumonia and rheumatism [16]. Since from the beginning of this century, there has been an increasing interest in the study of medicinal plants and their traditional use in different parts of the world. Organizing together those studies is very important to provide the ethnomedicinal and pharmacological information's on those plants. There for this paper reviewed and provided the ethnomedicinal uses, phytochemistry and pharmacological properties of *Solanum incanum* L. As much as possible up to date information on

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the plant has been searched and provided whenever it was available in English.

## 2. Description of the plant

The Family Solanaceae is monotypic family with 98 genera and some 2,700 species. About 60% of the species are grouped under eight genera's [17]. *Solanum incanum* L. is a native African shrub which belongs to family Solanaceae [18]. It is a delicate perennial plant often cultivated as an annual crop. It grows 1–3 m high with simple leaves, ovate, elliptic, 2.5–12 cm long and 2.5–8 cm wide. The fruit is fleshy, less than 3 cm in diameter on wild plants but much larger in cultivated forms. Botanically the fruit is classified as a berry and contains numerous small, soft seeds which are edible, but are bitter because they contain an insignificant amount of nicotinoid alkaloids [19]



**Figure:** *Solanum incanum* L. (Source, [20])

The raw fruit have a bitter taste but becomes tender when cooked and develops a rich complex flavor. The globose fruits are bright orange in color. It is herb or shrub with spines on the stem, leaves, stalks and calyces, and with velvet hairs on the leaves. Flowers are in clusters along the branches corolla pale to deep blue, purple, occasionally white. Fruit is spherical, green, often striped or mottled with white, turning yellow to orange brown when ripe [21].

Taxonomic classification of *Solanum incanum* L. [22]

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Solanales
Family	Solanaceae
Genus	<i>Solanum</i> L.
Species	<i>Solanum incanum</i> L.

*Solanum incanum* L. is a species of night shade that is common to North Western and the Middle East Africa also [23]. The herb is widely distributed across both the Eastern and Western hemisphere [24]. It is bushy herb that is widely distributed throughout the highlands of Kenya and is regarded as a noxious weed in widespread areas of Nairobi [25]. The plant is widely spread and very common in overgrazed range areas or road- sides of Ethiopia. It is also commonly known in Uganda, Tanzania, South Africa, Senegal, and Zimbabwe [26].

Some common vernacular name of *Solanum incanum* L. [22]

Amharic	Inboye
English	Apple of Sodam, bitter apple
Arabian	Ainalbaqar, arsam
Omar	mazi, helkem
Yemen	nuquum
Ndebele	Umdulukwa
Swahili	Tungujamito
Shona	Djinsa, dungwiza, mudulukwa

## 3. Ethnomedicinal Uses

Sore throat, stomach-ache, head-ache, painful menstruation, liver pain and pain caused by onchocerciasis, pneumonia and rheumatism are treated with *Solanum incanum* L. throughout tropical Africa. For these purposes, leaf, root and fruit decoctions are drunk, roots are chewed and sap swallowed, whereas leaf paste, root infusions and pounded fruits are applied externally or rubbed into scarifications. Leaf sap is used for washing painful areas, and ash of burnt plants mixed with fat applied externally to treat pain. For relief of tooth-ache a root infusion is used as mouth wash, fruit or root is rubbed on the gums or smoke of burning seeds is inhaled [15]. Another widespread ethnomedicinal use of *Solanum incanum* L. is in the treatment of venereal diseases. Different parts of the plant are also widely used in the treatment of skin problems, including skin infections, ringworm, burns, sores, rashes, wounds, warts, ulcers and benign tumors. In addition, the plant is used to treat ailments like stomach problems, snake bites, chest pain, tonicities, skin wounds of cattle etc. Leaves, fruits, roots and seeds boiled in butter taken orally used also for stomach disorder [16 and 20]. In Uganda, Tanzania and South Africa extracts of leaves or flowers are used as ear drops to cure inflammations. In Senegal, Kenya, Uganda and Zimbabwe different plant parts are used to treat snakebites: a decoction of the roots is drunk, roots are chewed and sap is swallowed, and young chewed leaves or pulped fresh roots are applied to the bite wound. In Ethiopia fruit sap is mixed with butter and applied to cattle to control ticks and the boiled fruits are used as soap and in tanning leather [26].

## 4. Phytochemistry and Pharmacological property

Secondary plant metabolites which are called as the phytochemicals possess some of unknown pharmacological activities. Phytochemicals with adequate antibacterial efficacy can be used for the treatment of bacterial infections [27]. Although, different parts of *Solanum incanum* L. have been evaluated for its secondary metabolites investigation by employing various phyto-chemical compounds analysis methods. Among which the standard analytical method is the most commonly used methods. Using those methods scholars identified that alkaloid, steroid, risin, glycosides, flavonoid, sponin, tannins, triterpens and cardicglycosides were found to be the dominant compounds in the leaf part [28 and 29] whereas, flavonoids, saponins, steroids and tannins were found to be the known tested compounds of the fruit part [30]. The presence of important phytochemicals make the plant useful for treating different ailments and have a potential of providing useful drugs of human use. Though out the world extensive work has been carried out for the quantitative determination of the phytochemicals and pharmacognostic parameters which will help for setting

standards for crude drugs. In cause of this review, scientific work carried out to investigate antinociceptive and antipyretic effects of *Solanum incanum* L. root extract on animal models using tail flick and hot plate tests reported its significant antinociceptive and antipyretic activity in both hot plate and tail flick tests [33]. Antifungal activity of the immature and matured ethanol leaf extracts of the plant was also reported on *Botrytis fabae* [30].

**Table:** Reported some phytochemical compounds isolated from *Solanum incanum* L.

Type of phyto-compounds	Solvents used	Parts tested	Techniques used	Reference
Saponin, alkaloid, flavonoid, oxalate and cyanogenic glycoside	-	Fruit	Gravimetric method of AOAC	[28]
Alkaloid, amino acid, steroid, risin, glycoside, flavonoid, sponin, tannin, reducing sugar, triterpen and cardicglycosides	Methanol	Fruit	Various method	[29]
Flavonoid, saponin, steroid and tannin	Methanol, ethanol and aqueous	Leaf	Chromatographic method	[30]
Saponin, Oxalate and flavonoid	-	Fruit	Gravimetric method of AOAC	[31]
Alkaloid, solasodine and flavonoid	Aqueous	Fruit	Chromatographic method	[32]

Somewhere in Nigeria, the effect of Nigerian *Solanum incanum* L. on postprandial blood glucose levels of norm glycemic Nigerians was reported. The effect of the plant was also compared with those of other indigenous vegetables taken by diabetic patients. Compared with other vegetables (*Vernoni* and *Gongronema*), *Solanum incanum* L. elicited significant reductions in blood glucose levels [34]. The antischistosomal characteristics of aqueous and methanol extracts of *Solanum incanum* L. has been also reported the greatest effect of the extract on worm reduction, worm recovery and Immunoglobulin G specific immunological responses [35].

## 5. Nutritional and Chemical Values

The human body composition shows that it requires some nutrients which are substances in food that will nourish them. These nutrients must be supplied in sufficient quantities and in proper combinations to permit optimum growth, maintenance and repairs of tissues and reproduction. Daily allowance of each nutrient for different ages of human population has been recommended by Food and Agriculture Organization [36]. To ensure these recommendations various studies has been carried out on different plants which are used traditionally for medicinal/nutritional purpose though out world. Among those *Solanum incanum* L. was the one, which were investigated extensively to detect the effect of different processing methods on its  $\beta$  carotene and ascorbic acid contents. It was observed that the processing methods were caused significant reduction in the  $\beta$ -carotene and ascorbic acid contents of the plant [37]. Study carried out by Auta and his colleagues [31], for the determination of moisture, ash, crude lipid, crude fibre and nitrogen content in the raw and

heat processed sample of *Solanum incanum* L. revealed the reduction effect of heat treatment on crude protein, lipid and crude fiber content of the plant. The same work continued using photometry and automated atomic absorption Spectrophotometer assays showed insignificance of heat processing on the plants mineral component. Work that is initiated to provide information on the proximate, vitamins and minerals content of the plant revealed the presence of high moisture, crude protein and available carbohydrate contents in the plant extracts. Quantitatively, 1085.0 mg of protein, 39.14 mg of magnesium, 216.89 mg of potassium, 147.78 mg of manganese, 256.17 mg of copper, 149.34 mg of sodium, 326.50 mg of iron and 15.29 mg of calcium composition per 100 gm. dry weight of the extract was reported. This study also reported high ash and crude lipid, but low crude fibre and cgaaloric values of the extract [28].

## 6. Conclusions

In recent years, ethnobotanical and traditional uses of natural compounds, especially of plant origin received much attention as they are well tested for their efficacy and believed to be safe for human use. *Solanum incanum* L. is the traditional medicinal plants widely used to treat various types of ailments like sore throat, stomach-ache, head-ache, painful menstruation, liver pain, malaria, hypertension, stomach problem, asthma, diabetes, common cold and pain caused by onchocerciasis, pneumonia and rheumatism. Following these traditional base line information, many efforts have been made by researchers to verify the efficacy of the plant through scientific approach. Scientific validation of herbal medicine may eventually lead to more wide spread use of traditional medicines in cheaper health care systems. Based from its ethnomedicinal uses and pharmacological activities, this literature acknowledged the traditional use of *Solanum incanum* L. as a popular remedy for treatment of different ailments. This plant is also known as a rich source of phytochemicals, vitamins and minerals that might be medicinally important and/or nutritionally valuable. However the reported pharmacological investigations showed some degree of knowledge gaps on the in vitro antimicrobial activity screening test on the root extract of the plant. Compared to its traditional use the knowledge gap on in vitro scientific investigation of the plant is huge. Therefore further more emphasis should be given to validate the in vitro activities and to further characterization of fractions.

## 7. Acknowledgments

This work was supported by Biological and Cultural Research Center at Arba Minch University.

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