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### **Multidisciplinary Properties of *Solanum xanthocarpum*: A Review**

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#### **ABSTRACT**

Kantkari (*Solanum xanthocarpum*) of the family *Solanaceae* is one of the 'Dasamoola' and commonly used drug in Ayurveda. *Dasamoola* literally means combination of ten plant roots together. It comprises roots of fine big or major trees (*Brihat panchmoola*) and roots of fine small or major herbs (*Laghu panchmoola*). In traditional system of medicine, different parts like leaf, stem, flower, roots of *Solanum xanthocarpum* and plant as a whole are used. The drug is used as an antiasthmatic, hypotensive and cytotoxic activity, hypoglycaemic, anti-inflammatory, anti-tumor activity. *Solanum xanthocarpum* (*Solanaceae*) (SX) is an important medicinal herb in Ayurvedic medicine. Since, there are few articles on this plant, the present review is undertaken to summarize available data and compile all the updated information on its phytochemical and pharmacological activities.

**KEYWORDS:** Pharmacological activities, *Solanum xanthocarpum*

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## INTRODUCTION

The origin of Ayurveda has been lost in pre historic antiquity, but their characteristic concepts appear to have been nurtured between 2500 and 500 BC in India<sup>1</sup>. *Solanum xanthocarpum* schrad & wendl., commonly known as *Kantkari*, belonging to family *Solanaceae*. It is distributed in all districts in the plains & low hills throughout India; also grows as a weed along roadside and wasteland. It contains steroidal glycoalkaloid solasodine (about 0.2%), steroidal saponin, solamargine,  $\beta$ -solamargine, solasonine and solacarpidine. It is a prickly diffuse, bright green perennial herb, woody at the base, 2–3 m height, found throughout India, mostly in dry places as a weed along roadsides and waste lands<sup>2</sup>. SX has held a place of some importance in the Hindu *Materia Medica*, primarily as an expectorant and antipyretic. Various medicinal properties are attributed to it, particularly in the treatment of asthma, chronic cough and catarrhal fever. It is one of the members of the *Dashamula* (ten roots) of the Ayurveda<sup>3</sup>. A very prickly diffuse bright green perennial herb, somewhat woody at the base; stem is somewhat zigzag; branches are numerous, the younger ones clothed with dense stellate tomentum; prickles are compressed, straight, yellow, glabrous and shining, often exceeding 1.3 cm. Leaves are usually 5-10 in numbers and 2.5-5.7 cm in length, ovate or elliptic, sinuate or sub pinnatifid, obtuse or sub acute, stellately hairy on both sides, sometimes becoming nearly glabrous in age, armed on the midrib and often on the nerves with long yellow sharp prickles, base usually rounded and unequal-sided; petiole 1.3-2.5 cm long, stellately hairy. The berries are green and white strips when young but yellow when mature. They are 1.3-2 cm in diameter, yellow, or white with green veins, surrounded by the enlarged calyx. Seeds are 2.5 mm in diameter and glabrous. Calyx is nearly 1.3 cm long, densely hairy and prickly; tube short, globules. Lobes are 11 mm long, linear-lanceolate, acute and hairy outside.

## HABITAT

It occurs throughout India, in dry situations as a weed along the roadsides and wastelands. It is naturally propagated by seed in waste lands. It is also distributed in Ceylon, Asia, Malaya, Tropical, Auastrana and Polynessia<sup>4</sup>.

## ANTIASTHMATIC PROPERTIES

Bronchial asthma is an inflammatory disorder of the airways characterized by various airway obstruction, airway eosinophilic inflammation and bronchial hyper responsiveness<sup>5</sup> and is a global health problem that results from a complex interplay between genetic and environmental factors. Among several respiratory diseases affecting man, bronchial asthma is the most common disabling syndrome. A pilot study on the clinical efficacy of SX and *Solanum trilobatum* in bronchial asthma

were undertaken to prove the significant use of herbs in treatment of asthma. Major literature data supports use of whole plants. Studies evaluated the therapeutic effect of ethanolic extract of SX i.e. asthma relieving or antihistaminic, antiallergic property<sup>6</sup>. Studied also showed the effects of *Solanum xanthocarpum* extract on some of the parameters like smooth muscle relaxation, and antagonism of asthma mediators such as histamine, eosinophils and protection against mast cell degranulation which seemed to be prominent in pathophysiology of asthma<sup>6</sup>. Further they showed that ethanol extract of *Solanum xanthocarpum* shown a significant antihistaminic activity in histamine induced contraction in goat tracheal chain preparation. Thus, the significant inhibition of histamine induced contractions produced by ethanol extract of *Solanum xanthocarpum* flower on isolated goat tracheal chain preparation indicates that the *Solanum xanthocarpum* flower has antihistaminic (H1- receptor antagonist) action. While screening the all three extracts of flowers of *Solanum xanthocarpum*, results were indicative that only ethanolic extract of *Solanum xanthocarpum* at a dose of 50 and 100 mg / kg reduced milkinduced eosinophilia of statistical significance.

### **ANTI-FERTILITY ACTIVITY**

Solasodine, an alkaloid of *Solanum xanthocarpum* possesses antispermatogenic activity<sup>7</sup>. In earlier study, chronic administration of solasodine (20mg/kg each other day oral for 60 days) rendered male rats and dogs infertile. Mating test showed 87% infertility in rats, this returned to normal after 60 days cessation of drug feeding. Solasodine is well tolerated and inhibits spermatogenesis and Sperm motility. No significant change was noticed in the weight of testes and accessory sex organs. Solasodine is estrogen free but inhibits testosterone release from dispersed mouse Leydig cells (200 uM significantly inhibited unstimulated and LH stimulated release). Solasodine can be developed as male pill of plant origin<sup>8</sup>.

### **ANTHYPERLIPIDEMIC ACTIVITY**

The Antihyperglycemic activity was associated with increase in plasma insulin. Though the exact mechanism of action is not known, it could be due to increase pancreatic secretion of insulin from existing  $\beta$ -cells. It is known that certain alkaloids and flavonoids present in *Solanum xanthocarpum* exhibit hypoglycemic activity and is also known for their ability of beta cell regeneration of pancreas.

### **HYPOGLYCEMIC ACTIVITY**

The Kondh tribes of Dhenkanal district of Orissa, India use the hot aqueous extract of the matured fruits as a traditional medicine for the treatment of diabetes mellitus. The aqueous extract

showed significant hypoglycemic effect in both normal and streptozotocin induced diabetic rats at dose of 100 and 200 mg/kg. The activity showed by aqueous extract was comparable to that of standard oral hypoglycemic agent glibenclamide. The experimental results indicated that it exhibited a potent blood glucose lowering property both in normal and streptozotocin induced diabetic rats. The LD50 of the extract was found to be high indicating high margin of safety<sup>9</sup>.

## HEPATOPROTECTIVE ACTIVITY

In other investigation, *Solanum xanthocarpum* extracts was evaluated for hepatoprotective activity using CCl<sub>4</sub> induced hepatotoxicity in rats. The hepatotoxicity induced by CCl<sub>4</sub> is due its metabolites CCl<sub>3</sub>. Rats administered with CCl<sub>4</sub> but treated with *Solanum xanthocarpum* extracts showed significant increased in the level of enzyme which indicates the antioxidant activity of *Solanum xanthocarpum*. Jigrine is a polypharmaceutical herbal formulation containing aqueous extracts of 14 medicinal plants including *Solanum xanthocarpum* and used for liver ailments<sup>19</sup>. Further studied investigated the DPPH-free radical scavenging activity, hepatoprotective and antioxidant activity of Jigrine against galactosamine induced hepatotoxicity in rats<sup>10</sup>.

## CARDIOVASCULAR EFFECTS

Cardiovascular effects has been reported from Abana, a polyherbal formulation containing SX causes: (i) a direct sensitization of the atrium through an increase in permeability to Ca<sup>2+</sup> and (ii) an effect similar to withdrawal of chronic ISO administration, i.e. down regulation of beta adrenoceptors<sup>11</sup>.

## ANTIFILARIAL EFFECT

Antifilarial effects of the larvicidal potential of crude extracts of SX has suggested its suitability as an ecofriendly, effective larvicide in the management of mosquito populations and in limiting the outbreak of various vector borne epidemics<sup>12</sup>.

## APOPTOSIS INDUCING ACTIVITY

Study shows that steroidal constituents from *Solanum xanthocarpum* and *Asparagus racemosus* clearly have the capacity to tumor cell death and these natural products represent interesting lead compounds for the development of potential cancer therapeutics. This is the first report on apoptosis inducing activity of immunoside, which was found to be the most active inducer of apoptosis amongst all the compounds tested in the study in HCT 116 human colon carcinoma cell

line. Our data suggest that the presence of sugar moieties in *Solanum* compounds is associated with induction of necrotic cell death.

## MOSQUITO LARVICIDAL ACTIVITY

The fruit extracts of *Solanum xanthocarpum* revealed larvicidal activity against an *stephensi* and *Cx. Quinquefasciatus* and one culicine species *Ae. Aegypti*. Volatile oil obtained from *Solanum xanthocarpum* exhibited repellency against mosquito *Cx. quinquefasciatus* at a very lower concentration than those of the plants studied earlier. The lethal concentrations of fruit extract at LC50 and LC90 levels against *An. culicifacies*, *An. stephensi* and *Ae. aegypti* were determined as 0.112 and 0.258, 0.058 and 0.289 and 0.052 and 0.218% respectively. The root extract is also effective against anopheline and culicine mosquito species, though at higher concentrations in comparison to fruit extract<sup>13</sup>.

## ANTI-INFLAMMATION ACTIVITY

Stigmasterol, carpesterol and diosgenin showed antiinflammation effect<sup>14-15</sup>. Lupeol in *Solanum xanthocarpum* also acted as multi-target agent with immense anti-inflammatory potential, targeting key molecular pathways, which involved nuclear factor kappa B (NFkB), cFLIP, Fas, Kras<sup>16</sup>, phosphatidylinositol-3-kinase (P13)/Akt and Wnt/ $\beta$ -catenin in a variety of cells. Lupeol at its effective therapeutic doses exhibited no toxicity to normal cells and tissues. Hence, it may serve as atherapeutic and chemopreventive agent for treatment of inflammation<sup>17</sup>.

## CONCLUSION

The extensive survey of literature revealed that *Solanum xanthocarpum* is an important source of many pharmacologically and medicinally important chemicals, especially steroidal hormone solasodine and other chemicals like solasonine, campesterol, campeferol, diosgenin and various useful alkaloids. The solasodine is the most studied chemical constituent of SX which has a role in the production of sex hormones. The plant is extensively studied for the various pharmacological activities like antiasthmatic, hepatoprotective, cardiovascular, hypoglycemic and mosquito repellent properties. Various traditional claims like immunomodulation, hypolipidemic, antibacterial, sexual behavior, tolerance and dependence is not studied till the date and needs attention in this area to explore further medicinal values of this plant. Although the results from this review are quite promising for the use of SX as a multi-purpose medicinal agent, several limitations currently exist in the current literature. While SX has been used successfully in Ayurvedic medicine for centuries, more clinical trials should be conducted to support its therapeutic use. Moreover, the

therapeutic potential of the plant should also be checked when used in combination with other herbal drugs.

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