

PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE OF *SOLANUM XANTHOCARPUM* SCHRAD AND WENDEL: A REVIEW

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ABSTRACT

Solanum xanthocarpum Schrad and Wendel (Solanaceae) is commonly known as 'Yellow berried night shade'. It is a prickly diffuse, bright green perennial herb. *Solanum xanthocarpum* is an important medicinal herb in Ayurvedic medicine. In the traditional system of medicine, whole plant of *Solanum xanthocarpum* Schrad and Wendel regarded as one of the most significant plant species in traditional system of medicine. The plant is used in different parts of the world for the treatment of several ailments including skin diseases, inflammations, rheumatism, hernia, urolithiatic, muscle pain, gonorrhea, piles, and dysentery etc. In recent studies *Solanum xanthocarpum* Schrad and Wendel has been investigated for presence of a wide range of phytochemicals viz. alkaloids, sterols, saponins,

flavonoids and their glycosides and also carbohydrates, fatty acids, amino acids etc. Various traditional claims like anti-fertility, anti-inflammatory, antiallergic, Antihyperlipidemic and Antifilarial activity, snail killing effects of the plant are still remain to be validated scientifically. Therefore, the present reviews paper an attempt to compile an up-to-date and comprehensive review of *Solanum xanthocarpum* Schrad and Wendel that covers its traditional uses, phytochemical, pharmacological data.

KEYWORDS: *Solanum xanthocarpum* Schrad and Wendel, traditional uses, phytochemical, pharmacological profile.

INTRODUCTION

India with its knowledge of rich ancient traditional systems of medicine provides a strong base for the utilization of a large number of plants in general healthcare. Large number of

herbal drugs existing in India, very few has been studied systematically so far. Selection of scientific and systematic approach for the biological evaluation of plant products based on their use in the traditional systems of medicine forms the basis for an ideal approach in the development of new drugs from plants. One such plant is *Solanum xanthocarpum* Schrad. & Wendl. (Family: Solanaceae) commonly known as the “Indian night shade” or “Yellow berried night shade” (English) and “kantakari” (Sanskrit). 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.^[1] *Solanum xanthocarpum* Schrad. & Wendl 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.^[2] It is one of the members of the dashamula (ten roots) of the Ayurveda.^[3]

Taxonomic position

Table 1: Taxonomic position of *Solanum xanthocarpum* Schrad. & Wendl.

| | |
|----------|--------------------------------------|
| Kingdom | Plantae |
| Division | Magnoliophyta |
| Class | Magnoliopsida |
| Subclass | Asteridae |
| Order | Solanales |
| Family | Solanaceae |
| Genus | <i>Solanum</i> |
| Species | <i>xanthocarpum</i> Schrad. & Wende. |

Vernacular Names

Hindi: Kateli, Katai and Ringani

Gujrati: Bhoyaringani

Marathi: Dorall ringani

Sanskrit: Kantkari, Ksudra, Kantakarika, Dhavani, Nidigdha, Dusparsa, Agnidamani

Malyalam and Tamil: Kandankattiri

Oriya: Bhejibegun and Ankranti

Telugu: Garrapugatt-apu, Pinnamulaka, Nelamulka, Vankuda

Manipuri: Leipungkhanga

English name: Indian night shade or Yellow berried night shade

Synonyms of *Solanum xanthocarpum* Schrad & Wendel

Solanum virginianum L.,

Solanum surettense Burm. F.

Botanical description and distribution

It occurs throughout India, in dry situations as a weed along the roadsides and wastelands. In India, it is mainly grown in Uttar Pradesh, Punjab, Bihar, West Bengal, Assam, Uttarakhand and other North-Eastern States. It is also distributed in Ceylon, Malacca through South-East Asia, Malaya, tropical Australia and Polynesia. In Manipur, it is grown as a wild plant and distributed throughout the hills and valley. It is generally grown in March-April and bear fruits in May-June. It grows on all kind of soil but does not well on dry and hot temperate regions.

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. Filaments are 1.5 mm long, glabrous; anthers 8 mm long, oblong lanceolate, opening by small pores. Ovary is ovoid, glabrous; style glabrous.^[4]

Status of the plant in Ayurveda

Solanum xanthocarpum Schrad. & Wendl. is one of the members of the *Dasamula* (ten roots) of the Ayurveda. It is one of the herbs from the group *laghu panchmulas*- five minor roots, viz. *salaparni*, *prsniparni*, *brhati*, *kantakari* and *goksura*. Based on prickles, in Ayurvedic text it is also known as *duhsparsa*-difficult to touch, *bahu kanta*- of many prickles, *ksudrakanta*-having small prickles etc. Ayurvedic texts mentioned three varieties of the species viz. violet flowered, yellow flowered and white flowered (called *lakshmana*, which is rare).

Phytochemistry

Solanum xanthocarpum Schrad. & Wendl. plant contains alkaloids, sterols, saponins, flavonoids and their glycosides and also carbohydrates, fatty acids, amino acids etc. Structures of some phytoactive compounds from *Solanum xanthocarpum* Schrad. & Wendl. are illustrate in Table 2.^[2,5,11]

| Sr. No. | Phytoactive compounds | Phyto-constituents |
|---------|--|--|
| 1 | Flavones, Phenolics and Coumarins | Apigenin, Scopletin, Esculetin Coumarin, Methyl Caffeate and Caffeic acid |
| 2 | Steroids and Triterpenoids | Carpesterol, Campesterol, Lupeol, Cycloartenol, Stigmasterol and Cholesterol |
| 3 | Steroidal alkaloids and Glycoalkaloids | Solasodine, Diosgenin, Tomatidenol and α -Solamargine |
| 4 | Fatty acids | Linoleicacid, Oleic acid and Stearic acid |

Uses in traditional system of medicine

This herb is useful in bronchial asthma^[12,13], cough, chest pain, stopping vomiting, curing dropsy, hair fall, leprosy, itching, scabies and skin diseases amongst others. The species is also used in wound healing^[14] and cardiac diseases associated with edema. Krayer and Briggs^[15] reported the anti-accelerator cardiac action of solasodine and some its derivatives. The plant possesses anti-urolithiatic and natriuretic activities^[16], tumoricidal properties^[17] and also anti-allergic and anti-cancerous effects.^[18] Nasal administration of this herb is useful in reducing migraine and headache. The fumigation of the plant is helpful in piles. The decoction of the plant used in the treatment of gonorrhoea.^[19] The plant extract possesses antipyretic, antihelmintic, carminative, stomachic, febrifuge, laxative, rejuvenating and aphrodisiac properties apart from promoting conception. Roots of this plant are used in Dashmularista, an ayurvedic tonic for lactating mothers^[19] and severely used in rural areas as a successful preventive of small pox and measles. Roots paste is utilized by the Mukundara tribals of Rajasthan for the treatment of hernia. Roots are also administered in flatulence and to heal constipation. Stem, flowers and fruits are prescribed for relief in burning sensation in the feet. Leaves are applied locally to relieve body or muscle pain; while its juice mixed with black pepper is advised for rheumatism.^[19] Juice of berries used in sore throat whereas dried fruits are smoked in the form of cigarette to cure dental infection or toothache. Fruit extract of the species possesses anti-inflammatory activity^[18,20], which is due to a rare sterol-carpesterol.^[21] Seeds are beneficial in irregular menstruation and dysmenorrhoea.

Pharmacological aspects of *Solanum xanthocarpum* Schrad. & Wendl.:***Anti-fertility activity***

Solasodine, an alkaloid of *Solanum xanthocarpum* Schrad. & Wendl. possesses antispermatogenic activity.^[22] In Dixit VP 1980 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. The RNA, protein, sialic acid and glycogen contents of the test were reduced significantly, serum proteins, triglycerides, Serum enzymes (GOT/GPT /Alkaline phosphatase) nonesterified fatty acids levels were in normal range. 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.^[23]

Antihyperlipidemic 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 increased pancreatic secretion of insulin from existing β -cells. It is known that certain alkaloids and flavonoids present in *Solanum xanthocarpum* Schrad. & Wendl. exhibit hypoglycemic activity and is also known for their ability of beta cell regeneration of pancreas.^[24]

Hypoglycemic activity

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.^[25]

Antifilarial activity

Mohan et al. reported the larvicidal potential of crude extracts of *Solanum xanthocarpum* Schrad. & Wendl. and suggested its suitability as an ecofriendly, effective larvicide in the management of mosquito populations and in limiting the outbreak of various vector borne epidemics.^[26]

Anti-asthmatic activity

A pilot study on the clinical efficacy of *Solanum xanthocarpum* Schrad. & Wendl. and *Solanum trilobatum* in bronchial asthma were undertaken to prove the significant use of herbs in treatment of asthma.^[26] Major literature data supports use of whole plants. Vadnere et al. (2008) evaluated the therapeutic effect of ethanolic extract of *Solanum xanthocarpum* Schrad. & Wendl. i.e. asthma relieving or antihistaminic, antiallergic property.^[27]

Gautam et al. (2008) studied effects of *Solanum xanthocarpum* Schrad. & Wendl. 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.^[27] Further they showed that ethanol extract of *Solanum xanthocarpum* Schrad. & Wendl. 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* Schrad. & Wendl. flower on isolated goat tracheal chain preparation indicates that the *Solanum xanthocarpum* Schrad. & Wendl. flower has antihistaminic (H1- receptor antagonist) action. While screening the all three extracts of flowers of *Solanum xanthocarpum* Schrad. & Wendl., results were indicative that only ethanolic extract of *Solanum xanthocarpum* Schrad. & Wendl. at a dose of 50 and 100 mg / kg reduced milkinduced eosinophilia of statistical significance. *Solanum xanthocarpum* Schrad. & Wendl. at a dose of (50-100 mg/kg, i.p) showed significant mast cell stabilization as compared to standard drug Disodiumchromoglycate (DSCG).

Anti-inflammation activity

Stigmasterol, carpesterol and diosgenin showed Antiinflammation Effect.^[28,21] Lupeol in *Solanum xanthocarpum* Schrad. & Wendl. 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, phosphatidylinositol-3-kinase (P13)/Akt and Wnt/ β -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 a therapeutic and chemopreventive agent for treatment of inflammation.^[29]

Snail killing activity

α -Solamargine from fruit of *Solanum xanthocarpum* Schrad. & Wendl.^[30] shows an excellent effect of in killing (100% at 28°C) *Oncomelania* snails in solution of α -Solamargine (0.2 mg/L).

Anti-allergy effect

Apigenin has shown anti-allergic effect of apigenin in ovalbumin (OVA)-induced asthma model mice.^[31] OVA- induced mice showed allergic airway reactions and included an increase in number of eosinophils in bronchalveolar lavage (BAL) fluid, an increase in inflammatory cell infiltration into lung around blood vessels and airways, airway luminal narrowing, and development of airway hyper-responsiveness (AHR). Administration of apigenin before last airway OVA challenge resulted in a significant inhibition of all asthmatic reactions.

CONCLUSION

Solanum xanthocarpum Schrad. & Wendl. is an important source of many pharmacologically and medicinally important chemicals, particularly steroidal hormone solasodine and other chemicals like solasonine, campesterol, campeferol, diosgenin and various useful alkaloids. *Solanum xanthocarpum* Schrad. & Wendl. safe for human use and is regarded as a valuable plant in both Ayurvedic and modern drug development areas for its versatile medicinal uses. The plant is widely studied for the various pharmacological activities like antiasthmatic, hepatoprotective, cardiovascular, hypoglycemic and snail killing properties. Most of the pharmacological studies were preliminary, carried out in animals and are not sufficient for the development of a pharmaceutical product. Further studies of other phytochemical compounds will possibly lead to exploration of new method for therapeutic and industrial application.

Keeping in mind that herbal medicines are gaining growing interest because of their cost effective and eco-friendly attributes, this is an urgent need to meet the ever growing demand of medicinal plants in the researcher, farmers, conservationist, and policy makers to manage the use our natural resources wisely. The review on *Solanum xanthocarpum* Schrad. & Wendl. is in light of it.

REFERENCES

1. Anonymous, The Wealth of India-Raw materials, Council of Scientific and Industrial Research, New Delhi, 1989; 393–394.
2. S. Siddiqui, S. Faizi & B. Siddiqui, Studies in the chemical constituents of fresh berries of *Solanum xanthocarpum*, J Chem Soc pak, 1983; 5(2): 99-101.
3. L. Mohan, P. Sharma & C.N. Srivastava. Southeast Asian J Trop Med Public Health, 2007; 38(2): 256-260.
4. K.R. Kirtikar & B.D. Basu, Indian Medicinal Plants, (International book distributors, 2005; III: 1759-1761.
5. P. Dubey & P. C. Gupta, A new flavonol glycoside from the flowers of *Solanum xanthocarpum*, Phytochemistry, 1978; 17: 2138.
6. G. Kusano, J. Beisler & Y. Sato, steroidal constituents of *Solanum xanthocarpum*, Phytochemistry, 1973; 12: 297-401.
7. J. Beisler & Y. Sato, chemistry of Carpesterol, a novel sterol from *Solanum xanthocarpum*, J Org Chem, 1971; 36: 3946-3950.
8. S.V. Tupkari, A.N. Saoji & V.K. Deshmukh, Phytochemical study of *Solanum xanthocarpum*. Planta Med, 1972; 22: 184–187.
9. M. P. Gupta & S. Dutta, chemical examination of the seeds of *Solanum xanthocarpum* scharf & Wendel. Part II. The constituents, J Ind Chem Soc, 1938; 15: 95.
10. G. Kusano, T. Takemoto, J. Beisler & Y. Sato, Steroidal constituents of *Solanum xanthocarpum*, Phytochemistry, 1975; 14: 529-532.
11. G. Kusano, T. Takemoto, J. Beisler & D. F. Jhonson, Norcarpesterol and related sterol from *Solanum xanthocarpum*, Phytochemistry, 1975; 14: 1679-1680.
12. S. Govindan, S. Vishwanathan, V. Vijayasekaran, & R. Alagappan, A pilot study on the clinical efficacy of *Solanum xanthocarpum* and *Solanum trilobatum* in bronchial asthma, J Ethnopharmacol, 1999; 66(2): 205-210.
13. S. Govindan, S. Vishwanathan, V. Vijayasekaran, & R. Alagappan, Further studies on the clinical efficacy of *Solanum xanthocarpum* and *Solanum trilobatum* in bronchial asthma, Phytother Res, 2004; 18(10): 805-809.
14. N. Kumar, D. Prakash, & P. Kumar, Wound healing activity of *Solanum xanthocarpum*, Indian J Nat Prod Resour, 2010; 1(4): 470-475.
15. O. Kraymer, & L. H. Briggs, Studies on *Solanum* alkaloids: II the anti-accelerator cardiac action of salsodine and some of its derivatives, Br J Pharmacol, 1950; 5: 517.

16. V. B. Patel, I. S. Rathod, & J. M. Patel, Anti-urolithiatic and natriuretic activity of steroidal constituents of *Solanum xanthocarpum*, *Der Pharma Chemica*, 2010; 2(1): 173-176.
17. E. A. Mazzi & K. F. Soliman, In vitro screening for the tumoricidal properties of international medicinal herbs, *Phytother Res*, 2009; 23(3): 385-398.
18. O. M. Singh & T. P. Singh, Phytochemistry of *Solanum xanthocarpum*: an amazing traditional, *J Sci Ind Res healer*, 2010; 69: 732-740.
19. N. Sharma, A. K. Sharma, & R. Zafar, Kantikari: A prickly medicinal weed ~ *Ecosensorium*, *J of Phytol Res.*, 2010; 9(1): 13-17.
20. S. Anwikar, & M. Bhitre, study of the synergistic anti-inflammatory activity of *Solanum xanthocarpum* schrad & Wendl and *Cassia fistula* Linn, *Int J Ayurveda Res*, 2010; 1(3): 167-171.
21. T. K. Bhattacharya, M. N. Ghosh, & S. S. Subramanian, A note on anti inflammatory activity of carpesterol, *Fitoterapia*, 1980; 51: 265-268.
22. V. P. Dixit, & R. S. Gupta, Antispermatogenic/antiandrogenic properties of solasodine (C₂₇H₄₃O₂N) obtained from *Solanum xanthocarpum* berries on the male rats and dogs, *J Steroid Biochem.*, 1986; 25: 27s.
23. V. P. Dixit, Antifertility effects of Solasodine obtained from *Solanum xanthocarpum* berries in male rats and dogs. Department of Zoology, University of Rajasthan, Jaipur: India, 1980.
24. M. Sridevi, P. Kalaiarasi, & K. V. Pugalendi, Antihyperlipidemic activity of alcoholic leaf extract of *Solanum surattense* in streptozotocin diabetic rats. *Asian Pacific Journal of Tropical Biomedicine*, 2011; 4(2): 276-280.
25. S. Gupta, M. Mal, & P. Bhattacharya, Evaluation of hypoglycemia potential of *Solanum xanthocarpum* (Solanaceae) fruits in normal and streptozotocin induced diabetic rats, *Eur Bull Drug Res.*, 13, 2005; 13: 51-55.
26. L. Mohan, P. Sharma, & C. N. Srivastava, Evaluation of *Solanum xanthocarpum* extract as a synergist for cypermethrin against larvae of the filarial vector *Culex quinquefasciatus* (Say), *Entomol Res.*, 2006; 36(4): 220-225.
27. G.P. Vadnere, R.S. Gaud, & A.K. Singhai, *Pharmacologyonline*, 2008; 513-522.
28. O. Gabay, C. Sanchez, C. Salvat, F. Chevy, M. Breton, G. Nourissat et al., A phytosterol with potential anti-osteoarthritic properties, *Osteoarthritis Cartilage*, 18, 2010; 18: 106-116.

29. M. Saleem, Lupeol; a novel anti inflammatory and anti cancer dietary triterpene, *Cancer Lett*, 2009; 285: 109-115.
30. Z. LI, X. Cheng, C. J. Wang, G. L. Li, S. Z. Xia, & F. H. Wei. Purification of effective component from *Solanum xanthocarpum* and its effect against *Oncomelania* snails. *Zhongguo ji Sheng Chong Xue Yu Ji Sheng Chong Bing Za Zhi*, 2005; 23: 206-208.
31. J. R. Choi, C. M. Lee, I. D. Jung, J. S. Lee, Y. Jeong, J. H. Chang, H. Park, W. Choi, J. Kim, Y. K. Shin, S. N. Park, & Y. Park, Apigenin protects ovalbumin- induced asthma through the regulatin of GATA-3 gene, 2009; 9: 918-924.