Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 9[5] April 2020 : 153-159

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.876
Universal Impact Factor 0.9804
NAAS Rating 4.95

REVIEW ARTICLE **OPEN ACCESS**

Comprehensive Phytopharmaceutical overview of *Solanum Xanthocarpum*

Pradeep Kumar Choudhary*[1] & Vishal Khandelwal
Department of Biotechnology , GLA University, Mathura. 281406
Corresponding Author's Email: Pradeep.choudhary@gla.ac.in

ABSTRACT
*Solanum is one of the largest and best-known genera of flowering plants is , about 1,500-2,000 species are present in this genera. Solanum have the colourfull flowers and shiny fruits and grow in the form of herbs, shrubs, and small trees. Cyphomandra and Lycopersicon (tomatoes) are isolated subgenera of Solanum. The generic name solanum given by the Pliny the Elder . Solanum xanthocarpum is a perennial herb, 2–3m height and foundin xerophytic condition in bare lands . S. xanthocarpum widely distributed in Srilanka, Asia, Malaya, Polynessia and also found in Southeast Asia, Malaya and tropical Australia. The role of Solanum xanthocarpum known for its medicinal potential from ancient timein regulating or modulating the cytokines or other biomolecules for the betterment of immune system and for other defence mechanisms of the body is yet to establish emphatically so that this plant could be used scientifically for treating immunity related disorders. **W**ater extract of Solanum xanthocarpum exhibits double edged mechanism on one side it down regulate the pro inflammatory cytokines and on other hand it caused over expression of anti inflammatory and immunoregulating cytokine ie., IL-10. Solanum xanthocarpum may have promising anti inflammatory action which may provide hope of cure the inflammatory diseases such as respiratory diseases, antioxidant stress, malignancy etc. The expression of TH1 and TH2 cytokines by HAESX may help to discuss their basic biology and clinical applications. Furthermore this study provides molecular based scientific evidence to support Indian system of medicine for the use of Solanum plant species as potential medicinal value in treating chronic inflammatory diseases that include respiratory disease (Asthma, Hey fever, Rhinitis, pulmonary edema), and many other degenerative immunological ailments .*
Key Words: *Solanum xanthokarpum, immunomodulatory, Anti asthamatic, Hot Aqueous Extract (HAESX).*

Received 11.03.2020 Revised 29.03.2020 Accepted 11.04.2020

INTRODUCTION

Solanum xanthocarpum Schrad. & Wendl. (Family: Solanaceae) described in the ancient Indian medicine system Ayurveda and in the "Charak sanhimta" commonly known as the Indian night shade or Yellow berried night shade [1]. It is one of the component of "Dasmula" and "Kantkari Ghrita" Dasmula provide the relief in gastric problem and Kantkari ghrita is given in the shore throat problem. The name "kantkari" and Jahar Kateeli is given to *S. xanthocarpum* because in some tribal region its root and fruit extract is given against the snake bite that is to cut the poison of snake (Jahar kateeli).

Plant name in different languages

Latin Names	*Solanum xanthocarpum*
English Name	Yellow Berried , Nightshade
Sanskrit Names	Kantakari, Nidigadhika
Hindi Name	Kateli Katai and Ringani
Bengali Name	Kantakari
Marwai Name	Bhuiringani
Gujarati Name	Bhoyaringani
Tamil:	Kantankattiri
Malayalam:	Kantkariccunta,Kantakarivalutana
Telugu:	Callamulaga, Pinnamulaka, Nelamulaka,
Kannad:	Nelagulle

Taxonomy

It is medicinal herb with spiney leaf and shoot having the woody base that is present all over the India specially in north east and east part of India [2,3]. *Solanum xanthocarpum* (SX) is a perennial herb, 2–3m height and foundin xerophytic condition in bare lands . *S. xanthocarpum* widely distributed in Srilanka, Asia, Malaya, Polynessia [4] and also found in Southeast Asia, Malaya and tropical Australia

Leaf: Leaves are 4-10.5 cm long and 2.5.5 cm wide, exstipulate, petiolate, ovate or elliptical , wavy margin, subacute hairy, green, clear midrib, having the spines, smell and taste are not defined .

Stem: Herbaceous, spiny, with defined node and internodes, green when young , branched, numerous hairs are preset over the stem, furrow and edge are present, young stems are circular. Mature stem are 8-10 mm thick slightly yellowish green and smooth, woody at the base, hollow pith is present .

Root: Root are tap about 10-45 cm 0.5-2 cm in diameter cylindrical, longitudinal and some transverse wrinkle are present, Scars are present on mature root that become woody and have the dark brown fractured bark.

Flower: Bracts are absent, mature pedicle, bisexual, regular complete flower, Valvate aestivation of calyx and corolla gamopetalous and gamosepalous, calyx are green, corolla are violet, tubular in shape, stamens are 5 in number epipetalous basifixed, short filament 1-1.5 mm long yellow coloured, anther are lanceolate 0.5-0.8 cm long, ovaru petamerous, hypogynaous, bilocular with axile placentation having infinite ovule.

Fruit: 0.8-1.5 cm diameter globular berry, unripe fruits are covered with white and green strip ahile mature fruits show the yellow and white varigation.[5]

PHARMACOLOGY

It is a traditional ayurvedic medicine for treatment of asthma and bronchitis. In Ayurvedic Pharmacopoeia of India it is officially included and is used in various Ayurvedic formulations. Fruit juice of *Solanum Xanthocarpum* are used in treatment of rheumatism and to treat various kind of throat infection. Against the gonorrhea its decoction is used to relieve the sprain and muscle pain leaf paste is useful. Diuratic properties of roots are used to treat the catarrhal fever. Expectorant properties are present in seeds so used to treat cough. It is used by tribals as folk medicines in treating snake bite, throat infections in children and against other inflammatory problems .The fruits are also used as anthelmintic, antipyretic and laxative.[6]

Arkadhi an ayurvedic preparation of *S.xanthocarpum* is use to increase the blood platlets so beneficial in dengue fever. It is beneficial in fever associated with chest infection [7].

Crushed whole plant mix with coconut oil is given to pregnant cattle during time of calf delivery. To relieve constipation in cattle a mixture of dry roots, powdered fruits with salt is given as an laxative.

Chemical constituents

Solanum xanthocarpum contain major alkaloid α Solamargine in fruit and seed, Steroidal alkaloids solasonine, solasurine, Solanidine , Steroid β Sitosterol , Camasterol , Stigmasterol present in fruits.Phenolic compounds coumerin and caffeic acid [8] present in fruit and leaf. SX also contain saponins, flavonoids and derivative of glycosides fatty acids, and carbohydrates. Several other studies on the genus Solanum showed the presence of phenolics. flavonoids, steroidal glycoside and steroidal saponins [9].

Depending upon climatic and soil conditions the solasodine content vary from 1.1% to 4.6% in the berries of Solanum xanthocarpum. It has been observed that in autumn season (Aug,September, October) only solasonine and solamargine is present and no solasurine present while in summer season berry solasonine, solamargine and solasurine present. In the unripe berries solasodine content yielded was 1.7% (on dry weight basis) as against 0.75% noted for the ripe berries.

BIOLOGICAL AND MEDICINAL USE

Kantkari (*Solanum xanthocarpum*) found throughout India [10]. The plant commonly known as Choti Kateeli, Jahar kateeli, Bhutkatya or Bhumiringani in Hindi is used in various form of medicine as in aayurveda, siddha, unani and in tribals in prepration such as decoction, aswa, ghrita, quatha etc. Dasmula Ashva contain the root of SX .

Vasocin (National Institute of Ayurvedic Medicine) contains *Solanum xanthocarpum* [11].

Antibacterial activity

Alcoholic and aqueous extracts of SX leaf show the antibacterial activity against gram positive and negative bacterial strains, It was observed that alcoholic extract show the antibacterial activity for both type of bacterial strains [12].In other studies showed that alcoholic extract of fruit show the antibacterial activity against the gram positive and negative bacteria but aqueous extract not show the antibacterial

activity. The alcoholic extract of leaf of *SX show the significant zone of inhibition* against *E.coli*, *S. aureus*, *A. niger* microorganisms. It was observed that 500µg leaf extract of *Solanum xanthocarpum* show the maximum zone of inhibition against the gram positive and negative bacteria[13].

It was reported that antibacterial activity of *Solanum xanthocarpum* extract could be studied by measuring the zone of inhibition formed around the disc. The extract of *Solanum xanthocarpum* showed moderate sensitivity to Escherichia coli [14]. It was observed that depending on the measured values of the complete inhibition diameter of the circle including the disc the millimeter, the antibacterial activity can be classified into highly sensitive (7-12mm), moderately sensitive (9-12mm), less sensitive (6-9 mm) and resistant (<6mm)[15].

It was noticed that several tannins, flavonoids and saponins to have antibacterial properties. So the antibacterial activity shown by the extracts of *Solanum xanthocarpum* might be due to some antimicrobial substances present in them *and* Ethanol extract of *Solanum xanthocarpum* due to the presence of alkaloids, glycosiede, saponins and tannins showed the maximum antibacterial activity which is somewhat comparable to that of standard antibiotics i.e. Ampicilline and Streptomycin [16].

It was reported that antibacterial activity was due to the presence of saponin and Staphylococcus aureus, the common wound pathogen sensitive to all the extracts used in the present investigation and it might be due to the total phonics components present in the plant [17]. It was reported that antibacterial activity of solanum extract due to the presence of cardiac glycosides, phenolic compounds, flavonoids and tannins. It was explore that antibacterial and urease inhibitory effects of silver nanoparticles prepared with berry fruits of SX and are effective against both antibiotic susceptible and antibiotic resistance strains of *Helicobacter pylori.*[18].

Antifungal activity

S. xanthocarpum aqueous extracts of various parts showed antifungal activity against *P. aeruginosa* and *A. niger.* Against the fungus *A. niger* most of the extract are much effective. Against the *A. Niger* 17 mm zone of inhibition was reported by the ethanolic leaf and root extracts while the acetone and methanol extract of *S. xanthocarpum*, also show the antifungal against A*. niger* with 22.4 and 27.5 mm zone of inhibition respectively. Steroidal glycocides and carpesterol and steroidal glycosides from the methanol extract of SX berry these compound show inhibitory action for the growth of *A. brassicae*., *Aspergillus niger* and *Trichoderma viride* [19,20]. Methanolic whole plant extract of *Solanum xanthocarpum* show the spore germination inhibition for fungi *A. fumigatus, A. flavus* and *A. niger* and having the MICs 1.25-2.50.[21] Aqueous and hexane extract of SX against the *Candida albicans* and *Aspergilus niger* was observed, aqueous extract was not effective against both the fungi but hexane extract show the antifungal activity against the *Candida albicans* [22].

Ethenolic extract of fruit and root of *Solanum xanthocarpum* 5% and 10% was effective against the ringworm causing fungi tricophyton and other dermatogens candida albicans and candida tropicalis and concluded that ethanolic fruit extract are more effective than root extract to combat the dermatogens [23].

Benzeene and petroleum ether fruit extract of SX show the inhibitory effect against the *Colletotrichum gleosporoides, Curvularia lunata ,Alternaria alternate* , *Macrophomina phaeseolus* and *Sclerotium rolfsii* and it was prove that petroleum ether inhibited the growth of *Colletotrichum gleosporoides, Curvularia lunata* and *Alternaria alternate* while *Macrophomina phaeseolus* and *Sclerotium rolfsii* remain uninhibited [24].

Antiasthmatic properties

Acording to WHO, 7–10% of the world population suffers from bronchial asthma . National institute of health define the asthma a chronic inflammatory disorder of respiratory tract and several mediator cell like mast cell, T-Lymphocytes, eosinophils, neutrophils and epithelial cells participate that result in bronchio spasm and series of inflammatory reaction started [25]. There are wide range of allopathic drug that are used to cure asthma but their effect is temporary and show several side effects so now a days herbal formulation gaining positive approach to treat asthma as they show bronchodialation, Stabilization of mast cell, anti-inflammatory and anti –allergic activities. Herbal drugs also inhibit the mediators like leukotriens, cyclooxigenase, lipooxigenase and cytokines [26].

Solanim xanthocarpum and *Solanum trilobatum* are widely used in siddha system to cure the respiratory disease [27,28] studied the *S. xanthocarpum* and *S. trilobatum* effect on bronchiodilated muscle using the drugs salbtamol and deriphylline. It was also evaluated the effect of ethanolic extract of SX as antihistaminic, antiallergic property [29].

In the pathophysiology of asthma mast cell degranulation, histamines and eosinophils level increased and it was observed that ethanolic extract of S. xanthocarpum relax the histamine induced contracted smooth muscle of goat trachea. Ethanolic flower extract of SX show that 50 and 100 mg/kg reduce the

eosinophill that was induced by milk and stabilize the mast cell degranulation as compared to control drug disodium chromo glycolate and concluded that SX flower has antihistaminic activity [29].
Ethanoloc extract of *S. xanthocarpum* used to study the anti asthmatic activity by using the acetylcholine and histamine induced constriction of guine pig respiratory track and paw oedemas induced by carrageenan, dextran and histamine in rat [30]. Solasodine alkaloide that is isolated from the root of S. xanthocarpum have the mast cell stabilizing and antiallergic activity [31].

Hypoglycemic activity

In 1980 WHO suggested the scientific community to evaluate the plant derived products to treat the diabetes and in the Indian system Ayurveda variety of plants mentioned to treat the diabetes [32]. Alcoholic leaf extract of *Solanum surattense* normalized the blood glucose level of rat treated with 100 mg/kg body wt leaf extract [33].
Hypoglycemic activity of the aqueous extract of SX was observed that have the insulin like properties it enhance the peripheral utilization of glucose, glucose level become down in alloxan treated hyperglycemic rat and in glucose feeded rat as compare with the glibenclamide treated rat that was standard control [34]. In Orrisa Kondh tribes of Dhenkanal district used the hot aqueous extract of the fruits for the treatment of diabetes mellitus and it was inferred that 100 and 200 mg/kg body wt hot aqueous extract have significant hypoglycemic effect in both normal and streptozotocin and alloxan induced diabetic rats and it is very safe because the LD50 of the extract was found to be very high [35]. Methanolic fruit extract of *Solanum torvum* lower the blood glucose level in streptozotocin induced diabetic in rats and it retain the B cell in pancrease [36].

Cardiovascular effects

It was observed that solasodine that is tertiary amine and trisacride derivative solamagrin has the antiaccelerater properties. Ethanolic extract of fruits of *Solanum indicum* show the hypotensive effect when it was given orally to rat that was administered intraperitoneal injection of N6 nitro-l-arginine methylester (L-NAME) that induce the hypertension in rat and herbal formulation containing SX causes increased Ca^{+2} permiability in atrium and down regulate the beta adrenoceptors [37].
Fruit extract of SX has cardiotonic activity, different dilution of fruit extract restored the cardiac activitity of hypodynamic frog heart and it was observed that undiluted fruit extract show better contraction of heart muscle than the diluted extract and its action is rapid compared to digoxin alkaloid [38].
It was observe that rat having the adrenal + deoxycorticosterone acetate regenerated hyper tension when treated with butanolic root extract of *Solanum sisymbrifolium* show the significant reduction of blood pressure [39].

Hepatoprotective activity:

In the hepatic toxicity hepatic cell become less functional and marker enzyme like alanin transaminase (ALT) , aspartate amino transferase (AST) and Alkaline phospatase (ALP) level become high . In the streptozotocin induced diabetic rat singnificant increase of ALT, AST and ALP takes place but when these rats are fed with the aquous leaf extact of *Solanum surattense* the level of hepatic marker enzyme markedly decreased [40].
It was investigated that the hepatoprotective and antioxidant activity of herbal formulation Jigrin having the aquous extract of Solanum xanthocarpum that was confirm by the DPPH free radical scavenging method [41]. Ethanolic fruit extract of *Solanum xanthocarpum* lower the serum ALT, AST and ALP in the rat have the liver toxicity induced by the antitubercular drugs [42]. 50% ethanolic fruit extract of SX exibit the hepatoprotective activity in carbon tetra chloride induced hepatic toxicity and it also lower down tha hepatic markers ALT, AST, ALP and Bilirubin and also restore the antioxidant enzyme GSH, SOD and catalase to normal level [43,44].

Larvicidal effect

It was investigated that carbon tetra chloride extract of *S. Xanthocarpum* show the larvicidal activity against the *Aedes stephesi* and *Culex quinquefasciants* alone and its efficacy increased in combination with pyrethoid and cypermethrin against the malaria vector and it was infered that cypermethrin and ether extract of *Solanum Xanthocarpum* in 1:1 ratio was most efficient [45] . similar effect of *Solanum nigrum* Rawani *et al.,*and *Solanum tribotum* [46] was observed against the *Culex quinquefasciants* larva when grow along with leaf extracts.) Upon storage SX efficacy decreases against the female anopheles larva to kill them, after six months storage of extract its activity reduced to two to three fold. Essential oil isolated from the leaf of SX by steam distillation method have the filarial vector repellent activity and it was reported that essential oil did not cause irritant activity on human skin [47].
Isolated protein from the *Solanum villosum* leave show the larvicidal activity against third instar larvae of *anopheles stephensi*, *Culex quinquifasciatus* and *Stegomyia aegypti* mosquito and found that proteins from the matured leaf show moderate larvicidal activity. Some worker used the ethanolic, hexane and

chloroform extract extract of leaf and stem of *Soloanum nigrum* against the larva of *Culex quinquefasciatus* and found that the leaf extract is more lethal than the stem extract [48].

Antioxidant activity

When the methanol extracts were prepared from the leaves of two varieties of *S. xanthocarpum* that were field grown and in-vitro raised . It was observed that these extracts posses efficient anti hyperglycemic activity at a concentration of 200 mg/kg and have antioxidant activity at this much concentration . The extracts prepared from the leaves of in-vitro raised *S. xanthocarpum* showed higher efficacy in comparison to the leaves that were field grown in all examined concentrations. Similarly when analysis for mineral and proximal composition were carried out , it was found that higher content concentration was present in in-vitro raised *S. xanthocarpum* than those that was field grown[49].

Anti inflamatory Activity:

It was studied that hot aqueous extraxt of *S. xanthocarpum* show the down regulation of TNF-α and interferon gamma (IFN-γ) of TH1(pro inflammatory cytokines and CMI inducer) and inhanced expression of IL-10 of TH2 (anti inflammatory in action). These findings clearly indicates that water extract of *Solanum xanthocarpum* exhibits double edged mechanism on one side it down regulate the pro inflammatory cytokines and on other hand it caused over expression of anti inflammatory and immunoregulating cytokine ie., IL-10. *Solanum xanthocarpum* may have promising anti inflammatory action which may provide hope of cure the inflammatory diseases such as respiratory diseases, antioxidant stress, malignancy etc [50].

FUTURE PROSPECTS

The role of *Solanum xanthocarpum* known for its medicinal potential from ancient time in regulating or modulating the cytokines or other biomolecules for the betterment of immune system and for other defence mechanisms of the body is yet to establish emphatically so that this plant could be used scientifically for treating immunity related disorders.

CONFLICT OF INTEREST :

The authors declare that there is no conflict of interest

REFERENCES

1. Khare. C.P., 1995. Encyclopedia of Indian Medicinal Plants; Published by Springer 432-433.
2. Kirtikar. K. R., and Basu.B. D. 1999. Indian Medicinal plant", Vol. II, International Book Distributors, Dehradun. 1158-1159.
3. Chopra, R.N., S.L. Nayar and I.C. Chopra, 2002. Glossary of Indian medicinal plants, National institute of science communication and information resources, CSIR, New Delhi. (Six Reprient) – 42, 214.
4. Sheth, A.K. (2005)The herbs of Ayurveda, First edition, Vol – IV, Hi scan private limited, Gujarat, 1200
5. Ghani, A. (1998)Medicinal plants of Bangladesh - chemical constituents and uses. Asiatic Society of Bangladesh, Dhaka.
6. Zakaria, Z. A., Gopalan, H. K., Zainal, H., Pojan, N. H. M., Morsid, N. A., Aris, A., & Sulaiman, M. R. (2006). Antinociceptive, anti-inflammatory and antipyretic effects of *Solanum nigrum* chloroform extract in animal models. *Yakugaku Zasshi*, *126*(11), 1171-1178
7. Sandhu, D.S. and Heinrich, M.,(2005) The use of health food,spices and other botanicals in the sikh community in London, Phytotherapy research, 19.633-642
8. Siddiqui, S., & Faizi. S.,(1983) Studies in the chemical constituents of the fresh berries of *S. xanthocarpum*, J Chem Soc Pak, 5,99-101
9. Kumar, P. M., Murugan, K., Kovendan, K., Subramaniam, J. and Amaresan, D., (2012). Mosquito larvicidal and pupicidal efficacy of *Solanum xanthocarpum* (Family:Solanaceae) leaf extract and bacterial insecticide, *Bacillus thuringiensis*, against *Culex quinquefasciatussay* (Diptera:Culicidae).Parasitol Res 110:2541-2550.
10. Yousaf, Z., Shinwari, Z.K. & Khan M.A. 2010.Phenetic Analysis of Medicinally Important Species of the Genus solanum from Pakistan. Pak. J. Bot. 42 (3): 1827-1833.
11. Amir, M., & Kumar, S. (2004). Possible industrial applications of genus Solanum in twentyfirst century-A review., Journal Scientific and Industrial research, 63(2)
12. Latha, P. S., & Kannabiran, K. (2006). Antimicrobial activity and phytochemicals of *Solanum trilobatum* Linn. *African Journal of Biotechnology*, *5*(23).
13. Sheeba, E. (2010). Antibacterial activity of Solanum surattense Burm. F. *Kathmandu university journal of science, engineering and technology*, *6*(1), 1-4
14. Udayakumar, R., Velmurugan, K., Srinivasan, D., & Krishna, R. R. (2003). Phytochemical and antimicrobial studies of extracts of *Solanum xanthocarpum*. *Ancient science of life*, *23*(2), 90
15. Arora, D. S. and Bhardwaj, S.K. (1997) Antibacterial activity of some medicinal plants, Geo Bios., 24, 127-131
16. Bader, G., Wray, V., & Hiller, K. (1992). Virgaureasaponin 3, a 3, 28-bisdesmosidic triterpenoid saponin from Solidago virgaurea. *Phytochemistry*, *31*(2), 621-623

17. Huang W.H. Hsu C.W.& Fang J.T., (2008): Central diabetes insipidus following digestion *Solanum indicum* L. concentrated solution .Clinical Toxicology, 46(4), 293 –96
18. Doss A., Mubarack H., & Dhanabalan R., (2009), "Antibacterial activity of tannins from the leaves of *Solanum trilobatum* Linn". Indian Journal of Science and Technology, 2(2)
19. Salar, R. K. (2009). Evaluation of antimicrobial potential of different extracts of *Solanum xanthocarpum* Schrad. and Wendl. *African Journal of Microbiology Research*, *3*(3), 97-100
20. Singh, O. M., Subharani, K., Singh, N. I., Devi, N. B., & Nevidita, L. (2007). Isolation of steroidal glycosides from *Solanum xanthocarpum* and studies on their antifungal activities. *Natural product research*, *21*(7), 585-590
21. Dabur, R., Gupta, A., Mandal, T. K., Singh, D. D., Bajpai, V., Gurav, A. M., & Lavekar, G. S. (2007). Antimicrobial activity of some Indian medicinal plants. *African Journal of Traditional, Complementary and Alternative Medicines*, *4*(3), 313-318
22. Shiv, G., Gaherwal, S., Shrivastava, C. S., & Wast, N. (2015). Antifungal activity of Aegle marmelos, Calotropis procera and Solanum xanthocarpum extract against Aspergillus niger, Candida albicans and Phenerochaete chrysosporium. *European Journal of Experimental Biology*, *5*(2), 81-89
23. Jain, R., Sharma, A., Gupta, S., Sarethy, I. P., & Gabrani, R. (2011). Solanum nigrum: current perspectives on therapeutic properties. *Altern Med Rev*, *16*(1), 78-85
24. Deepapriya, R., & Anitha, R. (2014). Efficacy of *Solanum xanthocarpum* Schrad. & Wendl. fruit extract on phytopathogenic fungi. *International Journal of Phytopharmacology*, *5*(2), 85-89
25. Taur, D. J., & Patil, R. Y. (2011). Mast cell stabilizing and antiallergic activity of Abrus precatorius in the management of asthma. *Asian Pacific journal of tropical medicine*, *4*(1), 46-49.
26. Mali, R. G., & Dhake, A. S. (2011). A review on herbal antiasthmatics. *Oriental pharmacy and experimental medicine*, *11*(2), 77-90
27. Govindan, S., Viswanathan, S., Vijayasekaran, V., Alagappan, R., 2004. Further studies on the clinical efficacy of Solanum xanthocarpum and Solanum trilobatum in bronchial Asthma. Phytotherapy Research 18,805–809.
28. 28.Govindan, S.,Viswanathan, S., Vijayasekaran, V., Alagappan, R.,1999. A pilot study on the clinical efficacy of *Solanum xanthocarpum* and Solanum trilobatum in Bronchial asthma.Journal of Ethnopharmacology 66,205-210
29. Vadnere,G.P.,Gaud, R.S. and Singhai A.K. (2008) Evaluation of Anti-asthmatic property of *Solanum xanthocarpum* flower extracts, pharmacologyonline. 2008 ;1: 513-522
30. Parmar, S., Gangwal, A., & Sheth, N. (2010). *Solanum xanthocarpum* (yellow berried night shade): a review. *Der Pharm Lett*, *2*(4), 373-383
31. Chitravanshi VC, Gupta PP, Kulshrestha DK, Kar K, Dhawan BN (1990) Anti-allergic activity of *Solanum xanthocarpum*. Ind J Pharmacol 22:23–24
32. Kandimalla, R., Kalita, S., Choudhury, B., & Kotoky, J. (2015). A review on anti-diabetic potential of genus Solanum (Solanaceae). *Journal of Drug Delivery and Therapeutics*, *5*(1), 24-27
33. Sridevi, M., Chandramohan, G., & Pugalendi, K. V. (2007). Protective effect of Solanum surattense leaf-extract on blood glucose, oxidative stress and hepatic marker enzymes in STZ-diabetic rats. *Asian J. Biochem*, *1*, 117-121.
34. Kar, D. M., Maharana, L., Pattnaik, S., & Dash, G. K. (2006). Studies on hypoglycaemic activity of *Solanum xanthocarpum* Schrad. & Wendl. fruit extract in rats. *Journal of Ethnopharmacology*, *108*(2), 251-256.
35. Gupta, A. K., Ganguly, P., Majumder, U. K., & Ghosal, S. (2009). Antidiabetic and antihyperlipidaemic effects of *Solanum xanthocarpum* total extract in alloxan induced diabetic rats. *Pharmacologyonline*, *1*, 484-497.
36. Gandhi, G. R., Ignacimuthu, S., & Paulraj, M. G. (2011). *Solanum torvum* Swartz. fruit containing phenolic compounds shows antidiabetic and antioxidant effects in streptozotocin induced diabetic rats. *Food and Chemical Toxicology*, *49*(11), 2725-2733
37. Amin, M., Anwar, F., Janjua, M. R. S. A., Iqbal, M. A., & Rashid, U. (2012). Green synthesis of silver nanoparticles through reduction with *Solanum xanthocarpum* L. berry extract: characterization, antimicrobial and urease inhibitory activities against Helicobacter pylori. *International Journal of Molecular Sciences*, *13*(8), 9923-9941.
38. Samuael, G.Y. and Henery, W., (2010) Comparative cardiotonic activity of Solanum xanthocarpum with digoxin on isolated frog heart , IJPI's J of pharmacology and herbal formula 2010-1(5) c1-6
39. Ibarrola, D. A., Hellion-Ibarrola, M. D. C., Alvarenga, N. L., Ferro, E. A., Hatakeyama, N., Shibuya, N., & Tsuchida, K. (2006). Cardiovascular Action of Nuatigenosido from *Solanum sisymbriifolium*. *Pharmaceutical biology*, *44*(5), 378-381.
40. Sultana, S., Perwaiz, S., Iqbal, M., & Athar, M. (1995). Crude extracts of hepatoprotective plants, *Solanum nigrum* and *Cichorium intybus* inhibit free radical-mediated DNA damage. *Journal of ethnopharmacology*, *45*(3), 189-192
41. Najmi, A. K., Pillai, K. K., Pal, S. N., & Aqil, M. (2005). Free radical scavenging and hepatoprotective activity of jigrine against galactosamine induced hepatopathy in rats. *Journal of ethnopharmacology*, *97*(3), 521-525
42. Hussain, T., Gupta, R. K., Sweety, K., Khan, M. S., Hussain, M. S., Arif, M., ... & Rao, C. V. (2012). Evaluation of antihepatotoxic potential of *Solanum xanthocarpum* fruit extract against antitubercular drugs induced hepatopathy in experimental rodents. *Asian Pacific journal of tropical biomedicine*, *2*(6), 454-460.
43. Lin, H. M., Tseng, H. C., Wang, C. J., Lin, J. J., Lo, C. W., & Chou, F. P. (2008). Hepatoprotective effects of Solanum nigrum Linn extract against CCl 4-iduced oxidative damage in rats. *Chemico-Biological Interactions*, *171*(3), 283-293
44. Gupta, R. K., Hussain, T., Panigrahi, G., Das, A., Singh, G. N., Sweety, K., ... & Rao, C. V. (2011). Hepatoprotective effect of *Solanum xanthocarpum* fruit extract against CCl4 induced acute liver toxicity in experimental animals. *Asian Pacific journal of tropical medicine*, *4*(12), 964-968.

45. 45.Mohan, L., Sharma, P., & Srivastava, C. N. (2007). Comparative efficacy of Solanum xanthocarpum extracts alone and in combination with a synthetic pyrethroid, cypermethrin, against malaria vector, Anopheles stephensi, Southeast Asian J Trop Med Public Health,38(2):256-60.
46. Pasnani, J. S., Hemavathi, K. G., Gulati, O. D., & Rajani, A. P. (1988). Effects of Abana, an Ayurvedic preparation, on rabbit atrium and intestine. *Journal of ethnopharmacology*, *24*(2-3), 287-302.
47. Bansal, S. K., Singh, K. V., & Kumar, S. (2009). Larvicidal activity of the extracts from different parts of the plant *Solanum xanthocarpum* against important mosquito vectors in the arid region, J Environ Biol.30(2):221-6
48. Chowdhury, N., Chatterjee, S. K., Laskar, S., & Chandra, G. (2009). Larvicidal activity of Solanum villosum Mill (Solanaceae: Solanales) leaves to Anopheles subpictus Grassi (Diptera: Culicidae) with effect on non-target *Chironomus circumdatus* Kieffer (Diptera: Chironomidae). *Journal of pest science*, *82*(1), 13-18.
49. Choudhary, P., Bhatia, A.K. and Goel, A.(2016) Efficacy of Antimicrobial and Antioxidant Activity of Solanum Xantocarpum Whole Plant hot Aqueous Extracts, Journal of pure and applied microbiology ,10,2,1403-1408
50. V Khandelwal, PK Choudhary, S Gupta, KK Chaubey, SV Singh, A Goel, and A.K. Bhatia. Immunosuppressive and anti-cancer potential of aqueous extract of *Solanum Xanthocarpum*, Indian Journal of Traditional Knowledge (IJTK) 18 (3), 451-457.

CITATION OF THIS ARTICLE

P K Choudhary & V Khandelwal. Comprehensive Phytopharmaceutical overview of *Solanum Xanthocarpum* . Bull. Env. Pharmacol. Life Sci., Vol 9[5] April 2020 : 153-159