World Applied Sciences Journal 36 (3): 529-536, 2018
ISSN 1818-4952
© IDOSI Publications, 2018
DOI: 10.5829/idosi.wasj.2018.529.536

Phytochemistry and Biological Importance of *Solunum surattense*

[1]Adila Sahar, [1]Kiran Aftab, [2]Asif Hanif Chaudhry and [3]Tanveer Akhtar Malik

[1]Department of Chemistry, Government College University, Faisalabad, Pakistan
[2]Chemistry Division, GARL, GSP, Islamabad, Pakistan
[3]Drugs Control and Traditional Medicine Division,
National Institute of Health, Islamabad

Abstract: *S. surattense* is one of the most potent plants of *Solanaceae* family used commonly as drug in ayurveda. Its different plant parts (stem, leaves, root and fruit) have remarkable potential against Gram +ve & Gram –ve and fungal pathogenic microbes. Also its plant parts have, anthelmintic, anti-convulsant, anti-hyperlipidemic, anti-malarial, anti-urolithiatic, natriuretic, anti-ulcer, wound healing, anti-asthmatic, hypoglycemic, anti-oxidant, hepatoprotective activity and cytotoxicity. Enriched evidences have been documented to show chemical constituents including alkaloids, saponins, steroids, tannins, flavonoids, glycosides, oleanolic acid, proteins, phenolic compounds and many other amino acids have been isolated and recognized. The aim of present study was to facilitate and to provide organized information on the pharmacological aspects of *S. surattense.*

Key words: *Solanaceae* · *S. surattense* · Natural Product · In-Vivo Activity · In-Vitro Activity · Phytochemical Constitution · Antimicrobial Activity · Antifungal · Updated Review

INTRODUCTION

Natural products have great importance regarding medicinal purposes. Natural products obtained from plants are key source for the formation of different derivatives which are used for medicinal purposes. Population in world still depends on herbal plants for their basic medical care. *Solanaceae* is a large family having two thousand and three hundred species which includes herbs, shrubs and small trees. This family is extensively known for the presence of natural products having immense medicinal value [1].

Solanaceae family is a highly potent family against number of diseases as immunosuppressive, cardiovascular, anti-hyperglycemic, free radical scavenging, anti-microbial, asthma, hepatoprotective, anti-tumor and as anti-depressant [2]. Therapeutically the paste of fruit of *Solanum surattense* is used externally for the cure of swelling and pimples [3]. This plant is also used in treatment of cold, worms, insomnia [4] laxative, enlargement of liver, aphrodisiac activities [5, 6] anti-nociceptive, molluscicidal and antifungal activities [7]. The stem, fruit and flower are used for the treatment of burning reaction in the feet escorted by vesicular blemish. Anti-diabetic properties were calculated in diabetic rats [8, 9].

Warm aqueous extract of dried fruit is used for the treatment of fever, cough and heart diseases [10]. *Solanum surattense* is widely used in domestic remedies. Its paste is used to reduce swelling and pain of joints. The paste of root mixed with lemon is used against snake's bite it is also much effective to reduce fever ant fats. It also acts as blood purifier [11].

Plants belonging to this family having much potential against infections, as anti-diabetic agents, anti-inflammatory and anti-cancer agents. Among the plants of *Solanaceae* family nearly half of the members belongs to Solanum genus. One of them is *Solanum surattense* Burm f. (syn: *Solanum xanthocarpum* schrad. & wendl.) which is much useful for its medicinal properties. It is a perennial herb [12-14].

Corresponding Author: Adila Sahar, Department of Chemistry, Government College University, Faisalabad, Pakistan.

Fig. 1: *Solanum surattense* with purple flower

Fig. 2: *Solanum surattense* with white flower

Suhas *et al*. [15] reported that methanolic extract showed antibacterial activity against Gram +ve bacteria (*Streptococcus aureus* and *Bacillus subtilis*) at 50, 75 and 100µg/ml concentrations.

Menghani and Sharma [16] reported for the antimicrobial potential of *Solanum xanthocarpum* against some selected fungi and bacteria. Results showed that the methanolic extracts of *Solanum xanthocarpum* have significant potential against selected microbes. Authors used Mytosin as standard drug. Fruit is eaten by local people for digestion and anthelmintic activity and its juice is used also for the treatment of diabetes mellitus and bad throat in Orissa, India [17]. Plant (Solanaceae) has resistance against respiratory disorder, stomach disorder, sore throat [18].

Geographical Distribution: It found in Polynesia, Australia, India, North Africa, South East Asia, Pakistan (KPN, Punjab, Azad Kashmir, Sindh and Baluchistan), Malaya and Ceylon [19]. Mostly it is present in dry places, at roadsides and waste areas [14].

Chromosomal Study: Rao reported that *Solanum surattense* has 2n=24 chromosomes by pachytene studies. Chromosomes are median (4), sub-median (6) and sub-terminal (2) and chromosomal length differs from 22.4µm to 41.3µm in species [20].

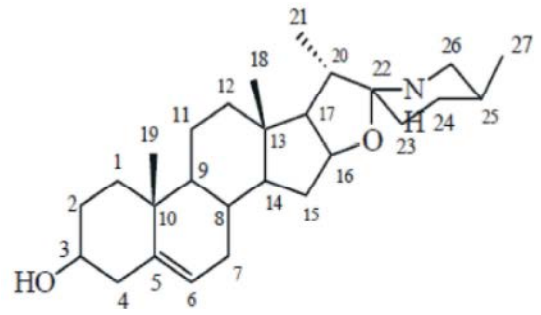
Morphology: It is a prostrate herb. Stem is cylindrical, 0.7-1.4 cm in width, greenish, prickly and much branched. Leaves are petiolate in which mid rib is much prominent. Flower colour is purple and other variety have white coloured flower which have 5 petals, 5 sepals, 5 stamens and anthers are small. Fruit colour is yellow and berry shaped that's it is called as "yellow berried night shade" [19].

Phytochemistry: The root of plant have Caffeic acid and Oleanolic acid in ethyl acetate fraction [21]. The fruit of plant has saponins which are useful for the cure of heart diseases [22]. Plant contains Stigmasterol, Diosgenin and Carpesterol which act as anti-inflammatory agent [23-25]. Lupeol in *Solanum xanthocarpum* showed therapeutic potential and also exhibit anti-inflammatory and anticancer action [26].

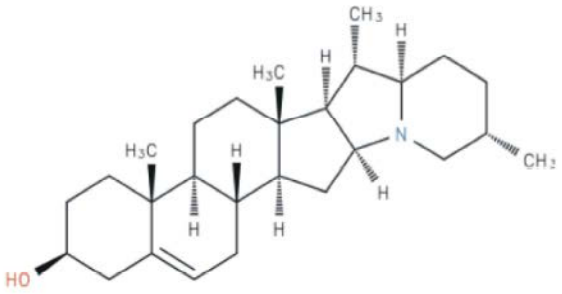
S. xanthocarpum constitutes apigenin and solamargine which showed remarkable anticancer activity [27, 28]. Leaves of plant contain Glycosides, Alkaloids, Phenolic compounds, Tannins, Flavonoids, steroids, amino acid, proteins, fats and carbohydrates [29].

Poongothai *et al.* [30] stated that leaves constitute alkaloids, saponins, steroids, amino acids and reducing sugar which showed antibacterial activity. From aqueous extract of fruit, â-sitosterol and stigmasterol obtained which showed significant immunomodulatory activity [31].

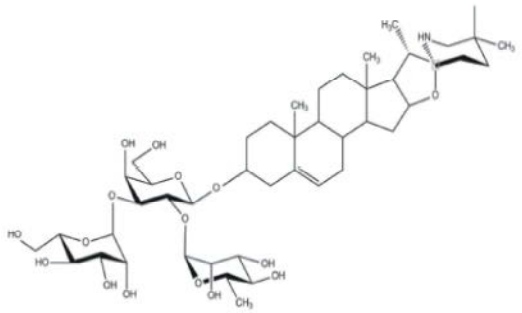
The fruit is reported to be full of many steroidal alkaloids like solanacarpidine, solasonine, solanacarpine, solamargine and solancarpine several other constituents like caffeic acid, coumarins (aesculin, campesterol, aesculetin, diosgenin, daucosterol) and triterpenes (cycloartenol and cycloartanol [32].



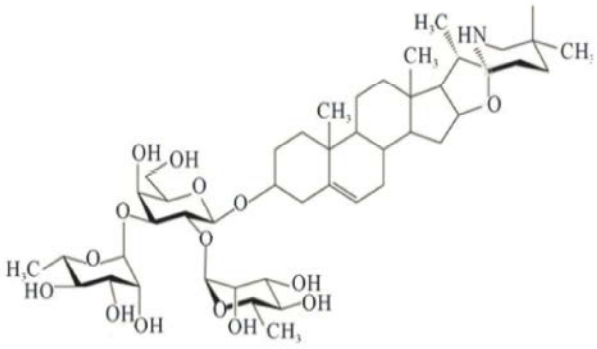
Solasodine (1)



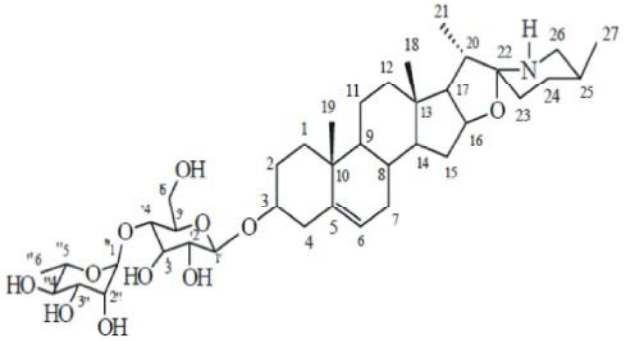
Solanidine (2)



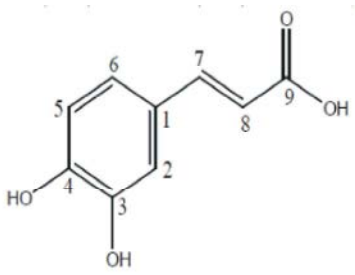
Solasonine (3)



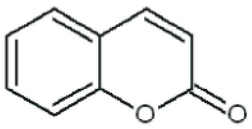
Solamargine (4)



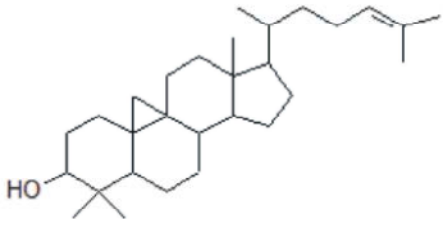
β-2 solamargine (Khasianine)(5)



Caffeic Acid (6)



Coumarins (7)



Triterpenes (8)

Antimicrobial Activity: Sheeba [33] evaluated that ethanolic leaf extract of the plant indicated antibacterial activity against *Streptococcus species, Vibrio cholera, Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, Salmonella typhi* and *Shigella dysenteriae.*

Kajaria *et al.* [34] detected that leaf extract exhibited MIC of 12.5 mg/ml for *Escherichia coli*, 16 mg/ml for *Pseudomonas aeruginosa* showed maximum zone of inhibition and 6.25 mg/ml against *Staphylococcus aureus*.

Mahmood *et al.* [35] evaluated antifungal effect against the growth of *Aspergillus niger* and *Aspergillus fumigates*. By using disc diffusion method antibacterial activity was conducted against *Enterobacter aerogenes, Staphylococcus aureus* (Gram positive) [15, 29& 35], *Escherichia coli* (Gram negative) [36], *Bacillus subtilis* [15] and *Vibrio cholera, Klebsiella pneumonia* and *Agrobacterium tumefaciens.*

Shah *et al*. [37] described in his study that non-alkaloid methanolic, non-alkaloid chloroform and non-alkaloid hexane extracts of *Solanum xanthocarpum's* fruit showed no antibacterial activity (in vitro) against *Escherichia coli, Bacillus subtilis*, *Pseudomonas aeruginosa* and *Shigella flexneri* while moderately exhibited activity against *Salmonella typhi.* By using ager tube dilution method Shah *et al* observed antifungal activity (in vitro) for *Aspergillus flavus* with non-alkaloidal chloroform extract.

David *et al.* [38] reported that methanolic seed's extract of *Solanum surattense* exhibited significant antifungal activity against *A .fumigates* and *Rhizopus oryzae* while the aqueous seed extracts recorded observable antifungal activity on *C. albicans* but did not show same effect on *C. krusei, A. fumigatus* , *C. kefyr, C. tropicalis*, *A. niger , Rhizopus oryzae* and *A. flavus*. The ethanolic seeds extract presented noticeable antifungal activity against *A. flavus, C. albicans, C. tropicalis, A. fumigates* and *A. niger*. Though, an in-between antifungal consequence of ethanol, aqueous and methanol seed extracts indicated on *C. krusei, A. flavus, C. kefyr, Rhizopus oryzae and A. fumigates* was examined

Arunkumar *et al.* [39] evaluated that the fallouts of antimicrobial activity explored that all the plant extracts had inhibitory effect such as *Bacillus subtilis*, *Staphylococcus aureus, Streptococcus pyogenes, Escherichia coli, Klebsiella pneumonia* and *Pseudomonas aeruginosa*. The chloroform and methanolic extracts repressed the growth of pathogenic bacteria 70 and 80%. Poongothai *et al.* [30] indicated that *S. xanthocar*pum leaf extract had great tendency against pathogenic organisms. He illustrated that methanolic and ethyl acetate leaf extract of *S. xanthocarpum* having distinct growth inhibitory activity of *S. paratyphi*, *E. coli*, *P. vulgaris*, *K. pneumoniae* and *P. aeruginosa.*

Gandhiappan *et al*. [40] revealed the antimicrobial effect of ethyl acetate, chloroform and methanolic extracts against *K. pneumonia, V. cholerae*, *M. luteus* and *S. aureus*.

Udayakumar *et al.* [41] illustrated in his study that antibacterial activity of petroleum ether, alcohol and acetone extracts of leaf, fruits and stem parts of *Solanum xanthocarpum* not in favor of *Klebsiella pneumoniae, Salmonella typhi, Escherichia coli* and *Bacillus cereus* were anticipated by zone of inhibition. *Solanum xanthocarpum* expressed high sensitivity to *Klebsiella pneumoniae* and *Salmonella typhi,* modest sensitive to *Escherichia coli* and less sensitive and dead set against to *Bacillus cereus*.

Salar *et al.* [42] revealed that the antimicrobial effect of various extracts against the fungus *Aspergillus niger* and *Escherichia coli*, *Pseudomonas aeruginosa* (Gram-negative), S*taphylococcus aureus*, *S. epidermidis* (Gram-positive) bacteria. A sturdy inhibition of *P. aeruginosa* was rooted by the methanolic and ethanolic extracts.

Anthelmintic Activity: Bhabanis *et al*. [43] said in his present study that tribal people use *Solanum surattense* Linn against helmintic activity. Authors tried to investigate the anthelmintic activity of aqueous and ethanolic extract showed anthelmintic activity at 10 mg/ml concentration. The activity compared with standard drugs Piperazine citrate and Aldendazole. Aqueous and ethanolic extracts showed better activity than standard drugs for adult Indian earthworms *Phertima postuma*. All the data was verified statistically by ANOVA at 5% level.

Gunaselvi *et al*. [44] explained that Helminthiasis is a global and common disease in all age groups. According to the research of WHO more than two billion people were suffered from this infection. Due to the cost and development, researchers pay keen attention towards the use of medicinal plants. After the marvellous work of many scientists, the natural sources for the treatment of anthelmintic were proposed from medicinal plants. Authors prepared methanolic and aqueous extracts of fruit of *Solanum xanthocarpum* which showed anthelmintic activity of parasite.

Priya *et al.* [45] prepared hydro-ethanolic, ethanolic and aqueous extracts of different concentrations (100, 50 & 25 mg/ml in distilled water). Authors took three worms of almost same type per concentration in it. Piperazine citrate (10 mg/ ml) drug was used as standard and distilled water as control.

Anticonvulsant Activity: Birari *et al*. [46] showed that the anticonvulsant activity of whole plant of *Solanum*

surattense was done by uninterrupted hot Soxhlet extraction technique using petroleum-ether (40-60°C) and methanol solvents one-to-one and lastly with Chloroform-Water maceration and measured against MES and PTZ induced seizures in rats. The aqueous and methanolic extracts indicated noteworthy ($p<0.01$) activity in MES induced seizures by decreasing tonic hind limb lean-to phase than pet-ether and chloroform when equate to control. Also methanolic and aqueous extracts meaningfully ($p<0.01$) postponed the onset of clonic convulsions induced by pentylenetetrazol. The evaluations revealed that methanolic and aqueous extracts of whole plant of *Solanum surattense* have the anticonvulsant activity.

Gurunath *et al.* [47] reported that methanolic and aqueous extracts of *Solanum surattense* Burm F. exhibited remarkable activity ($P \geq 0.01$) in PTZ and MES induced seizures in rats as it is done by dropping tonic hind limb extension stage.

Anti-Hyperlipidemic Activity: Sridevi *et al.* [48] studied the effect of administration of *Solanum surattense* and glibenclamide in diabetic rats brought back the rate of increase in blood glucose and decrease in insulin level to normal. Authors also showed that in diabetic rats plasma lipoproteins were changed and low density lipoprotein cholesterol (LDL-C) and very low density lipoprotein cholesterol (VLDL-C) increased and high density lipoprotein cholesterol (HDL-C) decreased on treatment with *Solanum surattense* and glibenclamide.

Antimalarial Activity: Ramanazi *et al.* [49] reported that *Solanum surattense* without any toxicity showed distinct anti-malarial activity in vitro ($IC_{50} \leq 50$ µg/ml) and in vivo. The strongest anti-plasmodial activity was shown by dichloromethane extract. Joseph *et al*. [13] explained in their review article that *Solanum xanthocarpum* (Schrad and Wendl) is a very potent plant against various diseases. Its leaves, root, stem and flower extracts showed remarkable antispasmodic [50], anti-asthmatic, anti-tumor, anti-inflammatory, anti-pyretic, anti-hypotensive, anti-tussive, antihistamine, hypoglycemic and cytotoxic activity [51]. As compared to the fruit extract though in higher concentration, root extract of the plant showed significant activity against anopheline and other clinical species of mosquitoes [52].

Anti-Urolithiatic and Natriuretic Activity: Patel *et al*. [53] tested the methanolic extract of *Solanum xanthocarpum* fruit for the anti-urolithiatic activity on (rats)and reported that solasodine showed significant anti-urolithiatic activity as compared to the natriuretic.

Anti-ulcer Activity: Bahuguna *et al.* [54] described different leaves extracts of *Solanum surattense* like petroleum ether, aqueous, alcohol and chloroform for antiulcer activity areas like pH, total acidity, free acidity and ulcer. Authors compared the antiulcer potential with standard drug Omeprazole. They reported that alcoholic extract showed promising antiulcer effect and fulfil other parameters.

Potential Wound Healing Activity: Dervangan *et al.* [55] recorded that ethanolic extract *of Solanum xanthocarpum* showed significant wound healing potential and remarkable decrease in the wound area.

Anti-Asthmatic Activity: This plant is very useful for cough, fever and asthma [56]. Solasodine in *Solanum xanthocarpum* is helpful for the treatment of asthma and it act as bronchodilator [57, 58]. Parmar *et al.* [59] reported that ethanolic leaf extract of *Solanum xanthocarpum* had significant anti-asthmatic activity and serve as bronchodilator. Parmar *et al* used guinea pigs as experimental specimens

Hypoglycemic Activity: Kar *et al*. [8] evaluated that aqueous extract of fruit of *Solanum xanthocarpum*; it showed significant hypoglycaemic activity in mice and rats. Kar *et al.* recorded that aqueous extract may have direct insulin like activity which exhibited pancreatic effect due to the enhancement of utilization of glucose. Gupta *et al*. [9] stated that aqueous extract of *Solanum xanthocarpum* showed remarkable hypoglycemic effect in induced diabetic rats (normal and streptozotocin) at dose of 100 and 200 mg/kg. The noted activity of aqueous extract was compared with the standard drug glibenclamide. The experimental data told that it exhibited lowering in blood glucose in both normal and Streptozotocin induced rats. The LD50 of the extract was evaluated to be highly suitable for the safeguard form diabetes.

Antioxidant Activity: Thirumalai *et al*. [60] reported the effect of aqueous extract of *Solanum surattense* seed on the oxidative potential of cauda epididymal spermatozoa in male albino rats.

Hepatoprotective Activity: *Solanum xanthocarpum* considerably (P<0.05- <0.001) and dose-feebly prohibited chemically induced increase levels of hepatic enzymes in serum. In addition, this plant extensively (up to P<0.001) reduced the lipid per oxidation in the liver tissue [61].

Testing of liver tissue exhibited that *Solanum xanthocarpum* weaken the hepatocellular necrosis and result in diminution in provocative cells permeation. This study sturdily evaluated the protective effect of S. xanthocarpum against liver injury which is credited to its hepatoprotective activity [62].

Cytotoxicity: Sidambaram *et al.* [63] found that acetone leaf extract of *Solanum xanthocarpum* caused more than 50 % cytotoxicity to HEp-2 cells (at what Conc.??) and at the concentration of 625 µg/ ml , it acts as effective drug. This concentration is nontoxic to Vero cells. Shah *et al.* [37] described that methanolic crude extract of *Solanum xanthocarpum'* fruit showed slight cytotoxic effect (LD50 (µg/ml) = 350.8944 µg/ml) while other all fractions were having no cytotoxicity.

REFERENCES

1. Hema, R., S. Kumaravel and K. Alagusundaram, 2011. Screening of whole plant extract of *Solanum surattense* for antibacterial activity. Indian Institute of Crop Processing, Thanjarur, Taminadu-613005, India.
2. Maurya, R. and J. Akansha, 2010. Chemistry and Pharmacology of Withania coagulens: An Ayurvedic remedy. Journal of Pharma Pharmacol., 62: 153-160. Make references like this style.
3. Gupta, M.P. and S. Dutt, 1938. Chemical Examination of the Seeds of *Solanum xanthocarpum*. II. Constituents. Journal of the Indian Chemical Society, 15: 95-100.
4. Mathur, D. and R.C. Agrawal, 2011.Withania coagulans: A review on the morphological and pharmacological properties of the shrub. World Journal of Science and Technology, 1(10): 30-37.
5. Gupta, R.K., T. Hussain, G. Panigrahi, A. Das, G.N. Singh, K. Sweety, M. Faiyazuddin and C.V. Rao, 2011. Hepatoprotective effect of *Solanum xanthocarpum* fruit extract against CCl_4 induced acute liver toxicity in experimental animals. Asian Pacific Journal of Tropical Medicine, pp: 964-968.
6. Kiritikar, K.R. and B.D. Basu, 2005. Indian Medicinal Plants. 2nd ed. Dehradun: Bishen Singh Mahendra Pal Singh, pp: 1759-1762.
7. Bhutani, K.K., A.T. Paul, W.Fayad and S. Linder, 2010. Apoptosis inducing activity of steroidal constituents from *Solanum xanthocarpum* and Asparagus racemosus. Phytomedicine, 17: 789-779.
8. Kar, D.M., L. Maharana, S. Pattnaik and G.K. Dash, 2006. Studies on hypoglycaemic activity of *Solanum xanthocarpum* Schrad. and Wendl. Fruit extract in rats. Journal of Ethnopharmacology, 108(2): 521-256.
9. Gupta, S., M.P. Mal and Bhattacharya, 2005. Eur Bull Drug Res., 13: 51-55.
10. Joy, P.P., J. Thomas, S. Mathew and B.P. Skaria, 2001. Medicinal Plants Tropical Horticulture, Eds., Bose, T.K., J. Kabir, P. Das and P.P. Calcutta: Naya Prakash, 2: 449-632.
11. Sharma, A., S.M. Sharma, A. Mishra, S. Sharma, B. Kumar and A. Bhandari, 2011. A review on Thar plants used in liver diseases. International Journal of Research in Pharmacy and Chemistry, 1(2): 2231-2781.
12. Sheeba, E. and S. Palanivel, 2013. Callus Induction and Antifungal Studies on *Solanum surattense* Burm. F., Middle-East Journal of Scientific Research, 16(1): 122-126.
13. Gaherwal, S., G. Shiv and Nageshwar Wast, 2014. Anti-Fungal Activity of *Solanum xanthocarpum* (Kantkari) Leaf Extract, World Journal of Zoology, 9(2): 111-114.
14. Vijay, A.L., N. Srinivasan, S. Abburi, K. Karthikeyan, S. Mahalaxmi, 2015. Evaluating the Analgesic Efficacy of Solanum surattense (Herbal Seed Extract) in Relieving Pulpal Pain - An In-vivoStudy. Dentistry, 5: 288.
15. Suhas, P., J. Vijaya, S. Prasanna and S. Sudhir, 2009. Screening of Whole Plant Extract of *Solanum Surattense* for Antibacterial Activity. International Journal of Pharmaceutical Sciences, 1(1): 110-114.
16. Menghani, E. and K.S. Sharma, 2012. Antimicrobial activity of Juniperus communis and *Solanum xanthocarpum*. UPSR, 3(8): 2815-2818.
17. Nadkarni, A.N., 1954. Indian Materia Medica, Bombay Popular Prakashan, Bombay, India, pp: 286.
18. Malik, F., S. Hussain, T. Mirza, A. Hameed, S. Ahmad, H. Riaz, P.A. Shah and K. Usmanghani, 2011. Screening for antimicrobial activity of thirty-three medicinal plants used in the traditional system of medicine in Pakistan Journal of Medicinal Plants Research, 5(14): 3052-3060.
19. Yousaf, Z., M.A. Khan and Z.K. Shinwari, 2009. A new variety of *Solanum surattense* Burm. from Pakistan. Pakistan J. Botany, 41(5): 2097-2103.

20. Rao, B.G.S., 1975. Studies on the chromosomes of *Solanum surettense*. Econ Botany, 29(1): 79-86.
21. Bhatt, B., 2011. Chemical constituents of *Solanum xanthocarpum*. Journal of Chemical and pharmaceutical Research, 3(3): 176-181.
22. Sheth, N., 2010. *Solanum xanthocarpum* (Yellow Berried Night Shade): A review. Der Pharmacia Lettre., 2(4): 373-383.
23. Gabay, D., C. Sanchez, C. Salvat, F. Chevy, M. Breton, G. Nourissat, C. Wolf, C. Jacques and F. Berenbaum, 2010. Stigmasterol: a phytosterol with potential anti-osteoarthritic properties. Osteoarthritis Cartilage, 18: 106-116.
24. Shizuka, H., U. Taku, M. Noriko, Y.L. Joo, U. Keiko, N. Yuki, H. Shohei, T. Nobuaki, N. Toshihiko, Y. Rina, T. Nobuyuki and K. Teruo, 2006. Diosgenin attenuates inflammatory changes in the interaction between adipocytes and macrophages. Oncogene, 25: 1463-1473.
25. Bhattacharya, T.K., M.N. Ghosh and S.S. Subramanian, 1980. A note on anti-inflammatory activity of carpesterol. Fitoterapia, 51: 265-268.
26. Saleem, M., 2009. Lupeol, a novel anti-inflammatory and anti cancer dietary triterpene. Cancer Letter, 286: 109-115.
27. Siddique, Y.H., T. Beg and M. Afzal, 2008. Antigenotoxic effect of apigenin against anti-cancererous drugs. Toxicology *In vitro*, 22: 625-631.
28. Kuo, K.W., S.H. Hsu, Y.P. Li, W.L. Lin, W.L. Liu, L.C. Chang, C.C. Lin, C.N. Lin and H.M. Sheu, 2000. Anticancer activity evaluation of the Solanum glycoalkaloid solamargine: Triggering apoptosis in human hepatoma cells. Biochemical Pharmacology, 60: 1865-1873.
29. Neelima, N., N.G. Devis, M. Sudhakar and J.V. Kiran, 2011. A preliminary phytochemical investigation on the leaves of *Solanum xanthocarpum* . International Journal of Research in Ayurveda and Pharmacy, 2(3): 845-850.
30. Poongothai, K., P. Ponmurugan and K.S.Z. Ahmad, 2010. A comparative study of antibacterial potential and phytochemical analysis between field grown and tissue cultured plant-*Solanum xanthocarpum* Schrad. and Wendl. Journal of Pharmacy Research, 3(8): 1958-1960.
31. Khanam, S. and R. Sultana, 2012. Isolation of β-sitosterol and stigmasterol as active immunomodulatory constituents from fruits of *Solanum xanthocarpum* (Solanaceae). International Journal of Pharmaceutical Science and Research, 3(4).
32. Paul, A.T., S. Vir and K.K. Bhutani, 2008. Liquid chromatography-mass spectrometry-based quantification of steroidal glycoalkaloids from *Solanum xanthocarpum* and effect of different extraction methods on their content. Journal of Chromatogr A., 1208: 141-146.
33. Sheeba, E., 2010. Antimicrobial activity of *Solanum surattense* Burm F. Journal of Science and Technology, 6(1): 1-4.
34. Kajaria, D.K., M. Gangwar, D. Kumar, A.K. Sharma, R. Tilak, G. Nath, Y.B. Tripathi, J.S. Tripathi and S.K. Tiwari, 2012. Evaluation of Antimicrobial Activity and bronchodialator effect of a polyherbal drug-Shrishadi. Asian Pacific Journal of Tropical Biomedicine, pp: 905-909.
35. Mahmood, A., A. Mahmood and M. Mahmood, 2012. In vitro Biological Activities of Most Common Medicinal Plants of Family Solanaceae. World Applied Science Journal, 17(8): 1026-1032.
36. Saini, V., A. Middha, H.K. Kinger, M.S. Rathore and S.G. Rathore, 2006. Antibacterial and antifungal activities of *Solanum xanthocarpum* leaf. International Journal of Plant Sciences, 1(2): 367-368.
37. Shah, H.U., Z. Wasil, A.I. Shahd, T. Mahmood, R. Khan and M.I. Choudhary, 2010. Biological activities of Various Crude Fractions of *Solanum xanthocarpum's* Fruits. Journal of Chemical Society of Pakistan, 32(1): 104-108.
38. David, E., E.K. Elumalai, C. Sivakumar, S.V. Therasa and T. Thirumalai, 2010. Evaluation of antifungal activity and phytochemical screening of *Solanum surattense* Seeds. Journal of Pharmacy Research, 3(4): 684-687.
39. Arunkumar, S., M. Muthuselvam and R. Rajasekaran, 2010. Analysis of Phytochemical constituents and antimicrobial activity of some Southern India medicinal plants. Journal of Pharmacy Research, 3(8): 1841-1843.
40. Gandhiappan, J. and R. Rengasamy, 2012. Comparative Evaluation of Antimicrobial Activities of the Members of Solanaceae. Der Pharmacia Sinica, 3(3): 357-360.
41. Udayakumar, R., K. Velmurugan, D. Srinivasan and R.R. Raghu Ram Krishna, 2003. Phytochemical And Antimicrobial Studies of Extracts of *Solanum xanthocarpum*. Ancient Science of Life, XXIII(2).
42. Salar, R.K. and Suchitra, 2011. Antibacterial, Antifungal and Cytotoxic Studies on Leaf and Seed Extracts of *Solanum xanthocarpum* Shrad and Wendl. International Journal of Phytopharmacology, 2(2): 61-65.

43. Nayak, B.S., P.K. Jena, N.P. Sahu, U. Nayak and K.B. Patro, 2009. Comparative Study of anthelmintic activity between aqueous and ethanolic extract of *Solanum surettense* Linn. International Journal of Pharmacy and Pharmaceutical Sciences, 1(1).
44. Gunaselvi, G., V. Kulasekaren and V. Gopal, 2010. Anthelmintic activity of the extracts of *Solanum xanthocarpum* Schrad and Wendl fruits (Solanaceae). International Journal of Pharma Tech. Research, 2(3): 1772-1774.
45. Priya, P., J.A. Pal and R. Gopal, 2010. Antimicrobial activity, antioxidant and Anthelmintic activity of *Solanum xanthocarpum*. Pharmachogen Journal PHCOG J. Shri Ram Institute of Technology, Pharmacy, Madhotal, Near ITI, Jabalpur_482002.
46. Birari, R.B., M.V. Tote, S.A. Patil, S.S. Jalalpure, S.L. Shid and B.M. Habade, 2010. Anticonvulsant activity of whole plant of *Solanum surattense* Burm against MES and PTZ induced seizures in rats. Pharmacology Online, 1: 479-489.
47. Gurunath, H.M., V. Chature and D. Vaijinath, 2011. Anticonvulsant activity of whole plant of *Solanum surattense* Burm against MES and PTZ induced seizures in rats. International Research of Journal of Pharmacy, 2(1): 275-278.
48. Sridevi, M., P. Kalaiarasi and K.V. Pugalendi, 2011. Anti-hyperlipidemic activity of alcoholic leaf extract of *Solanum surattense* in streptozotocin-diabetic rats. Asian Pacific of Tropical Biomedicine, pp: 5276-5280.
49. Ramazani, A., S. Zakeri, S. Surdari, N. Khodakarim and N.D. Pjadidt, 2010. Invitro and in vivio anti_malarial activity of Boerharia elegans and *Solanum surattense*. Malaria Journal, 9: 124.
50. Bector, N.P. and Puri, 1971. *Solanum xanthocarpum* (Kantakari) in chronic bronchitis, bronchial asthma and non-specific unproductive cough - An experimental and clinical correlation.). AS. J. Assoc. Phys India, 19(10): 741.
51. Anonymous, 2002. Indian Herbal Pharmacopoeia. Revised ed. Mumbai: IDMA.
52. Mohan, L., P. Sharma and C.N. Srivastava, 2005. Journal of Environmental Biology, 26(2): 399-401.
53. Patel, V.B., I.S. Rathod, J.M. Patel and M.R. Brahmbhatt, 2010. Anti-urolithiatic and natriuetic activity of steroidal constituents of *Solanum xanthocarpum*. Der Pharma Chemica, 2(1): 173-176.
54. Bahuguna, Y., V. Juyal and K. Gusain, 2008. Pharmacological evaluation of *Solanum surattense* leaves for antiulcer activity. International Journal of Pharmacy Research, 1(2).
55. Dervangan, H., M. Bais, M. Jaiswal and V.K. Verma, 2012. Potential wound healing activity of the athanolic extract of *Solanum xanthocarpum* Schrad and Wendl leaves. Pakistan Journal of pharmacological Science, 25(1): 189-194.
56. Nadkarni, K.M., 2009. Indian Materia Medica, 3rd ed. Mumbai: Popular Publication, 1: 1156-1158.
57. Govindan, S.S., S. Viswanathan, V. Vijayasekaran and R. Alagappu, 1999. Apiolet study on clinical efficiency of *Solanum xanthocarpum* and *Solanum trilobatum* in bronchial asthma. Journal of Ethnopharmacol, 66(2): 205-210.
58. Yaheya, M. and M. Ismail, 2010. Antiasthmatic herbal drugs- A review. International Journal of Pharmacy and pharmaceutical Sciences, 2(3).
59. Parmer, T.K., A.P. Gangwal, T.R. Prajapati, K.B. Pandya, V.L. Ranjapariya and N.R. Sheth, 2010. Evaluation of anti-asthmatic activity of ethanolic extract of *Solanum xanthocarpum* leaves. Pharmacology Online, 2: 410-424.
60. Thirumalai, E.K., V.S. Therasa and E.K. Elumalai, 2012. Effect of *Solanum surattense* seed on the oxidative potential of cauda epididymal spermatozoa. Asian Pacific Journal of Tropical Biomedicine, pp: 21-23.
61. Gupta, R.K., R.K. Singh, A.K. Gupta, Vaishalia, N. Jain, S.R. Swain, S.K. Chaudhry, T. Hussain and C.V. Rao, 2012. Influence of in-vivo anti-hepatotoxic potential of *Solanum xanthocarpum* fruit extract against ethanol and D-galactosamine Induced Hepatopathy in Experimental Rodents, pp: 1-8.
62. Hussain, T., R.K. G upta, K. Sweety, M.S. Khan, M.S. Hussain, M. Arif, A. Hussain, M. Faiyazuddin and C.V. Rao, 2012. Evaluation of antihepatotoxic potential of *Solanum xanthocarpum* fruit extract against antitubercular drugs induced hepatopathy in experimental rodents. Asian Pacific Journal of Tropical Biomedicine, pp: 454-460.
63. Sidambaram, R.R., M.G. Dinesh, E.T. Jayalakshmi, S. Subair and K. Chandrasekaram, 2011. Antibacterial, antifungal and cytotoxic studies on leaf and seed extracts of *Solanum xanthocarpum* Shrad and Wendl. International Journal of Phytopharmacology. 2(2): 61-65.