IJLSR (2019), Vol. 5, Issue 7 **Review Article**

IJLSR INTERNATIONAL JOURNAL OF LIFE SCIENCES AND REVIEW

Received on 29 May 2019; received in revised form, 11 July 2019; accepted, 25 July 2019; published 31 July 2019

EXPLORING THE MEDICINAL IMPORTANCE OF *SOLANUM XANTHOCARPUM*: A REVIEW

Anika Mahmood [1], Partha Sanjana Jurashe [1] and Pritesh Ranjan Dash [* 2]

Department of Public Health [1], North South University, Dhaka, Bangladesh.
Department of Pharmacy [2], Jahangirnagar University, Dhaka, Bangladesh.

ABSTRACT: *Solanum xanthocarpum*, commonly known as Yellow Berried Nightshade or Kantakari, is a medicinal plant mostly found in the dry regions of India. Belonging to the family Solanaceae, this plant consists of several phytochemical and pharmacological properties. According to the researches and studies over the years, it is found that the therapeutic value of the plant lies in anti-inflammatory, a bronchodilator, anti-microbial, wound-healing, anti-cancer, anti-insecticidal, and other activities. The following review gives a critical assessment of the literature to date, combining the information on *Solanum xanthocarpum*, suggesting its botanical description, chemical constituents, and use in traditional herbal medicine.

Keywords: *Solanum xanthocarpum*, Pharmacological properties, Kantakari, Phytoconstituents, Solanaceae

Correspondence to Author:
Pritesh Ranjan Dash

Ph.D. Student, Department of Pharmacy, Jahangirnagar University, Savar, Dhaka, Bangladesh.

E-mail: pritesh.ju@gmail.com

INTRODUCTION: Plants with medicinal value, namely medicinal plants, have been considered by human beings from a long time ago without a doubt. Presently, a number of this natural source of drugs is in demand, and their acceptance is growing progressively [1]. According to the World Health Organization (WHO), traditional medicinal plants are natural plant materials being used at least or in the absence of industrial processing for the treatment of diseases at a local or regional scale [2]. As these plants contain components of therapeutic value, medicinal plants have been used as remedies for human diseases in India, China, Greek, Egypt, and where not.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.IJLSR.5(7).104-11

The article can be accessed online on www.ijlsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.IJLSR.5(7).104-11

The whole world has been utilizing plants for primary preventive and curative health care since ancient times. Additionally, several plants have been searched by the human race for the control of certain diseases [3]. One such plant of therapeutic importance is *Solanum xanthocarpum* (SX) Schrad and Wendl of the family Solanaceae, commonly known as Yellow Berried Night Shade mostly found in dry regions of India.

SX has been given a place of some importance in the Hindu Materia Medica, principally as an expectorant and antipyretic as various medicinal properties are recognized, particularly in the treatment of asthma, chronic cough and catarrhal fever [4]. This present study focuses on providing a review on SX based on the knowledge and research materials found over time, mainly concentrating on the chemistry and pharmacological uses.

Synonyms: *Solanum virginianum* L., *Solanum surettense* Burm. f.

Vernacular Names: English: Yellow-berried Nightshade / Indian Nightshade; Sanskrit: Nidigadhika / Kantakari; Hindi: Kanteli; Bengali: Kantakari; Nepalese: Areri.

Distribution: Occurrence of SX has been found throughout India, in dry conditions as a weed along the roadsides and wastelands [4], particularly in hills and valley of Manipur (Leipung-Khanga in Manipuri) [5]. It naturally spreads by seed in wastelands. However, it is also distributed in Ceylon and Malacca through South East Asia, Malaya, Tropical Australia, and Polynesia [4, 6].

Taxonomical Classification: [7]

Class: Magnoliopsida
Subclass: Asteridae
Order: Solanales
Family: Solanaceae
Genus: Solanum
Species: *S. xanthocarpum*

FIG. 1: *SOLANUM VIRGINIANUM* L.[7]

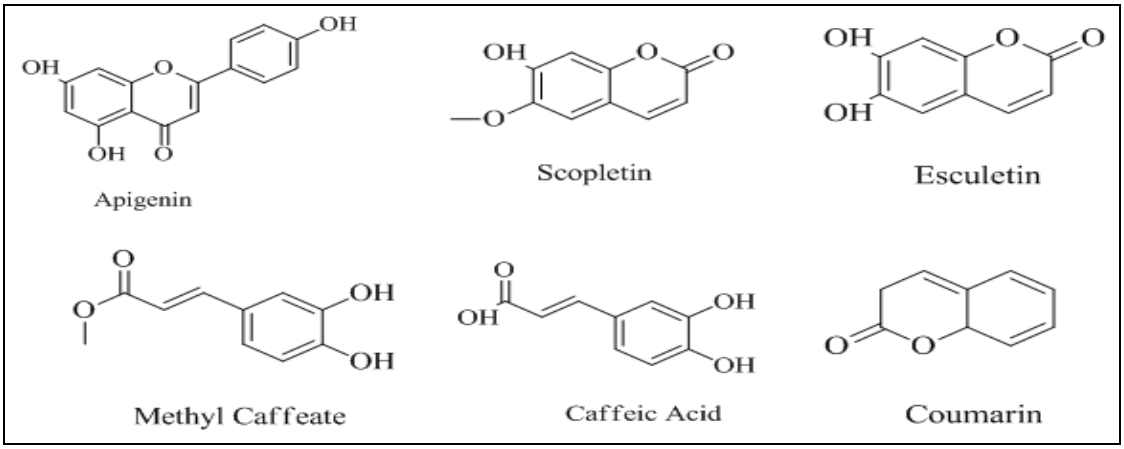
Botanical Description: A precise prickly turgid bright green perennial herb, woody at the base; the stem is somewhat zigzag; branches are abundant, the newer ones arrayed with dense stellate tomentum; prickles are compacted, yellow, straight, glabrous and shining, every so often exceeding 1.3 cm. 5-10 leaves in numbers, and they are 2.5-5.7 cm in length, elliptic or ovate, sub or sinuate, obtuse or sub-acute, stellate hairy on both sides. The base is usually rounded and unequal-sided; petiole 1.3-2.5 cm long, hairy.

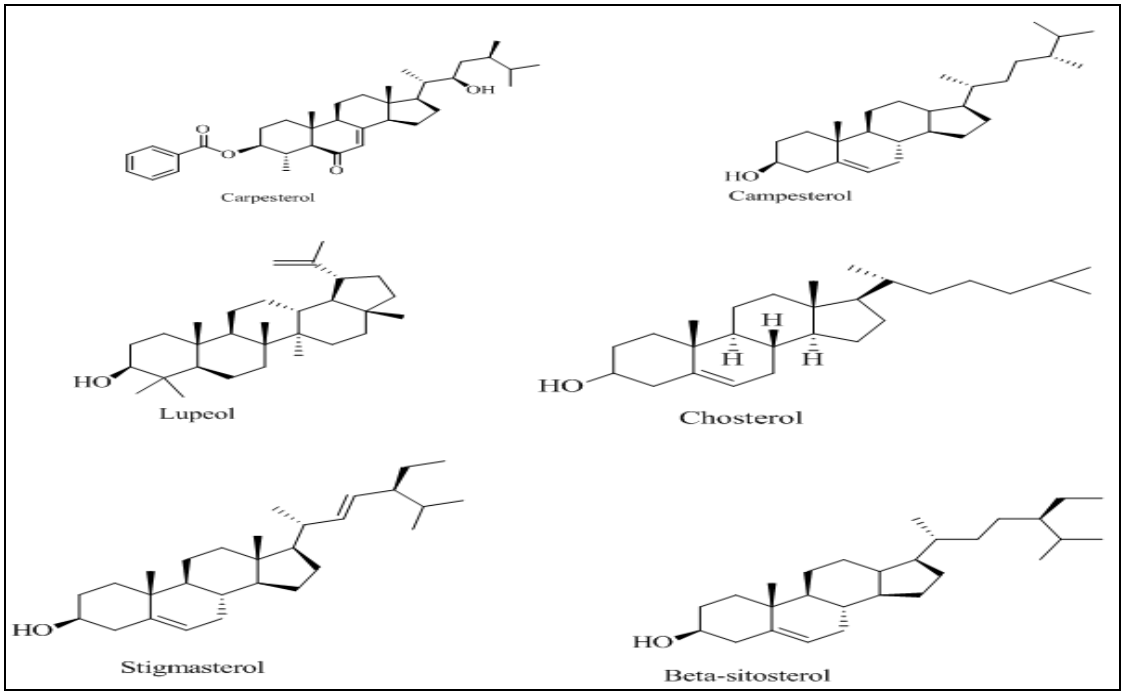
The berries are green and white strips (young) but yellow when mature. They are 1.3-2 cm in diameter, white or yellow with green veins, bounded by the inflated calyx. Seeds are 2.5 mm in diameter and glabrous. The calyx is approximately 1.3 cm long, closely bushy and sensitive; short tube, globules. Lobes are 11 mm long, linear-lanceolate, acute, and hairy outside. Filaments are 1.5 mm long, glabrous; anthers 8 mm long, oblong-lanceolate, small pores at the opening. The ovary is ovoid, glabrous [8].

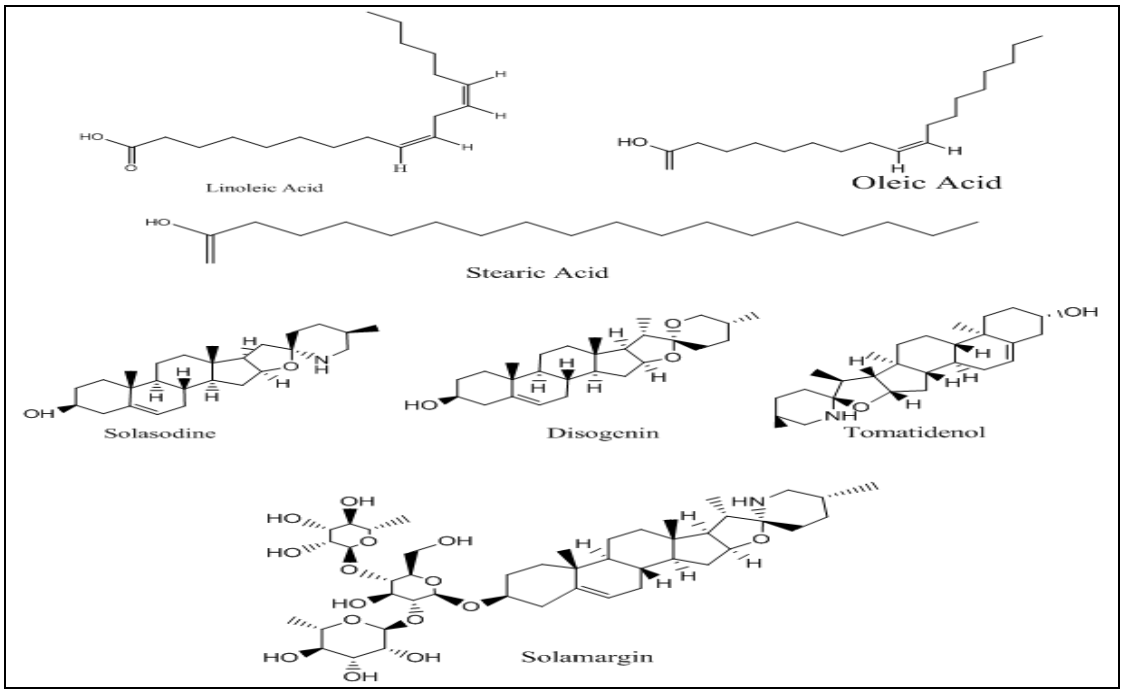
Chemical Constituents: The chemical constituents of plant *Solanum xanthocarpum* contain saponins, sterols, alkaloids, flavonoids, and their glycosides, as well as amino acids, fatty acids, carbohydrate, *etc.* [9] Analysis of berries of *Solanum xanthocarpum* led to the separation of solasonine, glycoalkaloid. Other two types of phenolic substances were obtained from the non-alkaloid part, which then identified as caffeic acid and methyl caffeate [10]. Moreover, the berries are the leading source of diosgenin and solasodine [11]. The fruits are conveyed to contain few steroidal alkaloids as in solancarpine [4] and solamargine [10], beta solamargine and solanocarpidine.

Dry fruits contain minimum amount of neochronogenic, chronogenic, isochlorogenic and caffeic acids. The petals and stamens yielded apigenin and quercetin diglycoside, sitosterol respectively. Two particular sterols are found in the unsaponifiable matter of fruits. One is carpesterol [12] (chemically the diosgenin) and beta-sitosterol constituents, however, researchers also found the occurrence of triterpenes (like lupeol) [13]. After the fruit extraction of *Solanum xanthocarpum* sitosterol, sitosteryl glucoside, cycloartenol, cycloartanol, solamargine, β-solamargine, campesterol, cholesterol, stigmasterol, and stigmasteryl glucoside were identified.

Additionally, an individual steroid was acknowledged, which was identical with 4α-methyl-(24R)-ethylcholest-7-en-3β-ol (synthesized from carpesterol) [14]. So, fruits extract more alkaloids than other organs in plant species also the production of alkaloids varies under altered organic diluters. Along with alkaloid, determined the incidence of flavonoids and saponins, except for trace amounts of heavy metals (Zn, Cd, Fe, Cu, and Pb) and also reported and measured khaisanine a bioactive glycoalkaloid through HPLC [15].


Apigenin
Scopletin
Esculetin
Methyl Caffeate
Caffeic Acid
Coumarin


Carpesterol
Campesterol
Lupeol
Chosterol
Stigmasterol
Beta-sitosterol


Linoleic Acid
Oleic Acid
Stearic Acid
Solasodine
Disogenin
Tomatidenol
Solamargin

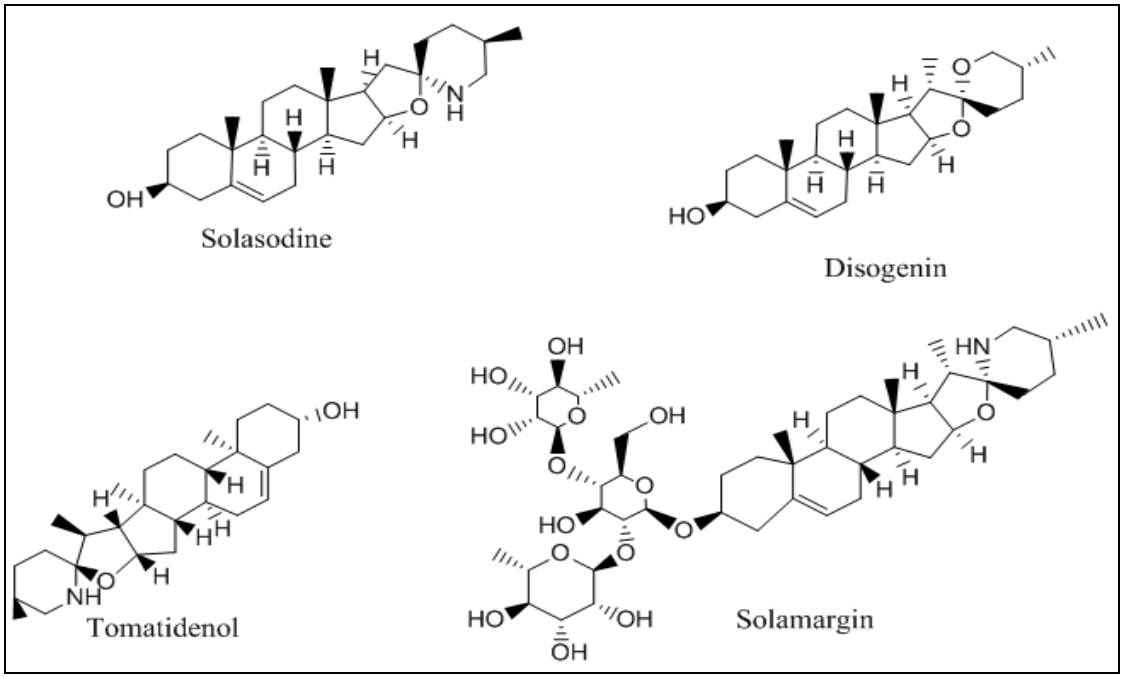


FIG. 2: COMPOUNDS ISOLATED FROM *SOLANUM XANTHOCARPUM*

Pharmacological Properties:

Hypoglycemic or Anti-hyperglycemic Activity: The hot aqueous extract of the matured fruits of SX is used as a traditional medicine for the treatment of diabetes mellitus among the Kondh tribes of Dhenkanal district of Orissa, India. This extract showed significant hypoglycemic effect in both normal and streptozotocin-induced diabetic rats at a dose of 100 and 200 mg/kg. Moreover, the activity showed by the plant extract was equivalent to that of standard oral hypoglycemic agent glibenclamide.

Therefore, the experimental results were concluded to exhibit potent blood glucose lowering property both in those diabetic rats. It was also found that the LD_{50} of the extract was high representing a high margin of safety [4]. According to a study conducted by Poongothai *et al.,* (2011), the hypoglycemic activity of the crude methanol extracts of the leaves of SX at different concentrations (100-200 mg/kg body weight) was tested against alloxan-induced adult diabetic male Wistar rats, and the anti-diabetic efficacy was validated through various biochemical parameters. Here, the phytochemical analyses of field grown SX and in vitro raised SX leaves were done by estimating their chlorophyll, carotenoids, total sugar, protein, amino acid, and minerals contents and the results revealed that the methanol extracts of both the leaves were efficient antihyperglycemic agents at a concentration of 200 mg/kg body weight [16].

Wound Healing Activity: Wound healing is the repairing processes that follow the skin and other soft tissues injury. When a wound occurs, an inflammatory response initiates and the cells below the dermis start to increase collagen production and later, the epithelial tissue is regenerated [17]. Kumar *et al.,* (2010), in their study, used healthy inbreed Sprague-Dawley rats to prove the wound healing property of fruit extracts of SX. Hot Soxhlet method was used to obtain the coarsely powdered fruits of SX extracted with methanol. When treated to the wounds, the methanolic extract of fruits (10% w/w) ointment had produced significant ($P<0.01$) increase in mean % wound contraction (104, 58 and 43%) after 4th, 8th and 12th day of treatment. Moreover, the wound contraction and tensile strength of the experimental ointment under test were found to be near control *Aloe vera* 10% cream [18].

Antifungal Activity: To evaluate the antifungal potential of the extract of *S. virginianum* poisoned food technique was used. The extract was effective in inhibiting fungal growth by a significant reduction in the colony growth on plates poisoned with the extract. The mycelial growth of all fungi was inhibited to >40%. Among fungi, noticeable susceptibility was recorded against *Curvularia sp.* (61.29% inhibition) and *Alternaria sp.* (61.14% inhibition) while *Fusarium sp*. was inhibited to a lesser extent (43.47% inhibition).

However, previous studies have shown the potential use of leaves, flower, stem, and fruit extracts in the inhibition of certain funguses such as *Aspergillus niger, Candida albicans, etc.* [7]

Anti-asthmatic / Bronchodilator Activity: Plant powder can be anti-tussive as its effect on bronchial asthma patient has been explained due to depletion of histamine from lung and its expectorant action because of the inorganic nitrogen presence [19]. It was found that SX has mild to moderate bronchodilator activity as an Ayurveda drug. This study included Soxhlet process for producing the plant extract, which was used in treating children with respiratory problem and wheezing. Significant results were found using the trial drug comparing with a standard one as 60.71% reduction in wheezing was seen with the trial drug. It was concluded that the alkaloids and steroids might have had inflammatory action on the bronchial tree that led to bronchospasm [20].

According to Vadnere *et al.*, (2008), noticeable inhibition of histamine-induced contractions produced by ethanol extract of SX flower on isolated goat tracheal chain preparation proved that the SX flower has antihistaminic (H1-receptor antagonist) action. While screening all three extracts of flowers of SX, results indicated that only ethanolic extract of SX at a dose of 50 and 100 mg/kg reduced milk induced eosinophilia of statistical worth. SX at a dose of (50-100 mg/kg, i.p) exhibited significant mast cell stabilization when compared to standard drug disodium chromoglycate [21].

Anti-inflammatory Activity: One study has found that the anti-inflammatory activity of SX is good as compared with standards (Ibuprofen drug). Additionally, this activity is maximum in the forms of ethanolic and chloroform extracts [22]. However, the aqueous extract of dried fruits of *Solanum xanthocarpum* Schrad and Wendl and dried pulp of another plant, Cassia fistula Linn was prepared to test the synergistic effect in case of anti-inflammatory property. The mentioned activity of these extracts was investigated using the carrageenan-induced paw edema model in rats individually and in two different combinations and as a result, both the extracts showed maximum anti-inflammatory activity at 500 mg/kg dose.

Among the different dose combinations of both the extracts, the 1:1 combination at the 500 mg/kg dose showed maximum percentage inhibition of 75%, which was comparable with the positive control, diclofenac sodium, which showed 81% inhibition [23]. Stigmasterol, carpesterol and diosgenin are responsible for showing the anti-inflammatory effect. Moreover, lupeol in SX also acted as multi-target agent with massive anti-inflammatory potential, targeting the key molecular pathways [5].

Anti-bacterial Activity: Antibacterial activity can be determined by plethora of methods, for instance, agar well diffusion, disk diffusion and broth diffusion. Amongst these to determine antibacterial activity in plant extracts (*in-vitro*) agar well diffusion is extensively used. Extract of SX has shown anti-bacterial activity against four gram positive bacteria, such as namely, *Staphylococcus aureus* NCIM 5345, *Staphylococcus epidermidis* NCIM 2493, *Bacillus subtilis* NCIM 2063, and *Bacillus cereus* NCIM 2016 and three Gram-negative bacteria, *i.e.*, *Escherichia coli* NCIM 2065, *Pseudomonas aeruginosa* NCIM 2200, and *Salmonella typhimurium* NCIM 2501. Selected bacteria's pure culture was maintained on nutrient agar slants. It was prepared by moving the pure cultures aseptically onto sterile nutrient broth tubes.

Then the tubes were incubated at 37°C. Afterward the broth cultures were used to gage their susceptibility to flower and leaf extract by 'agar well diffusion' [24]. Cork borer was used to punch the wells (diameter 8 mm) and then the wells were labeled and filled with chloramphenicol (reference antibiotic), DMSO and 100 µl of extract (25 mg/ml of DMSO). The plates were further allowed to stand for 30 min and again incubated for 24 h at 37 °C. Finally, the inhibition regions were formed around the wells and measured afterward [25].

Mosquito Larvicidal Effect: In various fields of pest management, the plant *Solanum xanthocarpum* has been used [26], however not exploited widely. The fruit extracts enclosed larvicidal activity against *A. stephensi*, *A. aegypti* (culicine species) and *C. quinquefasciatus* [27]. The volatile oil extracted from the SX fruit has repellency against *C. quinquefasciatus* at a poorer concentration on the subject of other plants. The lethal concentrations of fruit extract at LC_{50} and LC_{90}

levels against *A. culicifacies*, *A. stephensi* and *A. aegypti* were determined as 0.112 and 0.258, 0.058 and 0.289 and 0.052 and 0.218% respectively. Additionally, the root extract is effective at higher concentration against anopheline and culicine mosquito species [28].

Hepatoprotective Activity: A polypharmaceutical herbal formulation, *i.e.*, Jigrine, contains aqueous extracts of 14 medicinal plants, including SX. It is used for liver ailments. Case studies shared hepatoprotective activity, DPPH-free radical scavenging activity, and antioxidant activity of Jigrine against galactosamine-induced hepatotoxicity (in rats) [29].

Anti-cancer Activity: Lupeol [30], apigenin [31], and solamargine [32] revealed the anti-cancer property of SX. Chromatin condensation has shown in solamargine-treated cells, also DNA fragmentation and a DNA histogram (sub-G1 peak) suggested apoptosis in solamargin induced cells. Within 2 h of incubation with persistent concentrations of solamargine, the extreme number of dead Hep3B cells were discovered. Since the action of solamargine is irretrievable; prolonged incubation results in no further cell death. Determination of cell phase's susceptibility to solamargine-mediated apoptosis, Hep3B cells were coordinated at distinct cell cycles by colchicine, cyclosporin A, and genistein.

Cells in G2/M phases are comparatively predisposed to solamargine-mediated apoptosis. To boot, after solamargine treatment, a parallel up-regulation of TNFR (tumor necrosis factor receptor) I and -II on Hep3B cells were identified. Interestingly with either TNFR-I or -II specific antibody, solamargine- mediated toxicity could be neutralized. Thus their autonomous action evidences the contribution in solamargine-mediated apoptosis [5].

Anti-oxidant Activity: The mechanism of the anti-oxidant property of flavonoids consist of radical scavenging, metal ion chelation, reducing ability, and inhibition of enzymatic systems liable for free radical cohort [33]. Flavonoid constituents have persuasive water-soluble antioxidant properties which prevent oxidative cell damage. The free radical scavenging activity was measured by DPPH assay as modified by using methanol [34].

Presence of yellow colored spots against the purple context in TLC-DPPH plate assay specified potential antioxidant action in many subfractions of ethyl acetate, acetone and ethyl acetate extracts along with aqueous sample. The strength of the yellow color hinge on the extent and the nature of the composites present at that site [35]. Most of the SX fruit extracts except benzene and hexane verified appreciable radical scavenging activity at 250 μg/ml concentration enlightening substantial antioxidant possible in the extracts; facilitated by their hydrogen donating ability [36, 37]. Antioxidant activities of the *Solanum xanthocarpum* extracts varied expressively with diverse concentrations [38].

Preventing Post-Menopausal Syndrome: TLC analysis of SX confirmed the presence of one of the major constituents, steroids. A pilot study showed the estrogen activity of SX. In further studies, it has indicated effects on the postmenopausal syndrome. The postmenopausal syndrome is categorized by low estrogen levels leading to sexual dysfunction, depression, vaginal atrophy, and osteoporosis. In this study, β estradiol (1 mg/kg) and SX (200 mg/kg) exhibited noticeable improvement in sexual behavior parameters regarding postmenopausal syndrome [21].

CONCLUSION: Herbal medicines are gaining mounting interest since their ecofriendly and profitable features. Here, *Solanum xanthocarpum* is an imperative source of several medicinally and pharmacologically important chemicals, especially steroidal hormone solasodine and also campesterol, disogenin, solasonine, and many beneficial alkaloids. Moreover, SX is safe for human use and in both Ayurveda and modern treatment; it is viewed as a valuable plant for its numerous medicinal use. This plant is broadly studied for its hepatoprotective, hypoglycemic, anti-asthmatic, anti-microbial and other countless pharmacological activities. Further research on other phytochemical compounds may lead to the exploration of an innovative method for more therapeutic application.

ACKNOWLEDGEMENT: Authors are grateful to Jahangirnagar University, Department of Pharmacy, Savar, and Dhaka, Bangladesh for providing necessary facility to carry out study.

CONFLICT OF INTEREST: Authors declare no conflict of interest.

AUTHORS' CONTRIBUTION: The review was conducted under the supervision of Pritesh Ranjan Dash (PRD) who guided the study. The introduction was done by Anika Mahmood (AM). The synonyms and vernacular names were also retrieved by AM whereas the distribution of the plant was written collaboratively by AM and Partha Sanjana Jurashe (PSJ). Next, the taxonomical classification and botanical description were written by PSJ.

The image of the plant was collected from an article by AM. After that, the chemical constituents were explored by PSJ while the structures for them were drawn by PSJ and AM with the use of ChemDraw Ultra 12.0 software. In the next part, the pharmacological activities of the plant were described.

Here, AM contributed in the hypoglycemic or anti-hyperglycemic, wound-healing, anti-fungal, anti-asthmatic or broncho-dilator and anti-inflammatory activity whereas, PSJ contributed in anti-bacterial, mosquito larvicidal, hepatoprotective, anti-cancer, anti-oxidant and preventing post-menopausal activity. The abstract and the conclusion were written by AM and PSJ, respectively. All authors read and approved the final manuscript.

REFERENCES:

1. Jamshidi-kia F, Lorigooini Z and Amini-khoei H: Medicinal plants: Past history and future perspective. Journal of Herbmed Pharmacology 2018; 7(1): 1-7.
2. Tilburt JC and Kaptchuk TJ: Herbal medicine research and global health: an ethical analysis. Bull World Health Organ 2008; 86(8): 594-9.
3. Singh S and Sedha S: Medicinal plants and their pharmacological aspects. FPI 2017; 1(4): 156-70.
4. Parmar S, Gangwal A and Sheth N: *Solanum xanthocarpum* (Yellow Berried Night Shade): A review. Der Pharmacia Lettre 2010; 2(4): 373-83.
5. Singh OM and Singh TP. Phytochemistry of *Solanum xanthocarpum*: An amazing traditional healer. Journal of Scientific and Industrial Research 2014; 69: 732-40.
6. Rita P and Animesh DK: An updated overview on *Solanum xanthocarpum* Schrad and Wendl. International Journal of Research in Ayurveda and Pharmacy 2011; 2(3): 730-35.
7. PrashithKekuda TR, Raghavendra Hl, Avinash HC, Rajesh MR, Ankith GN and Karthik KN. Antimicrobial, Insecticidal, and antiradical activity of *Solanum virginianum* L. (Solanacea). Asian Journal of Pharmaceutical and Clinical Research 2017; 10(11): 2-6.
8. Kirtikar KR and Basu BD. Indian Medicinal Plants. 2005; 3: 1759-61.
9. Reddy NM and NRR: *Solanum xanthocarpum* chemical constituents and medicinal properties: A review. Scholars Academic Journal of Pharmacy 2014; 3(2): 146-49.
10. Siddiqui S, Faizi S and Siddiqui S: Studies in the chemical constituents of the fresh berries of *Solanum xanthocarpum* Schrad. and Wendle. J Chem Soc Pak 1983; 5(2): 99-102.
11. Gabbard R. Diosgenin and other steroid drug precursors Asolkar LV, Chadha YR and Rawat PS: Publications and Information Directorate. Steroids, 2003; 12: 170.
12. Heble MR, Narayanaswami S and Chadha MS: Diosgenin and beta-sitosterol: Isolation from *Solanum xanthocarpum* tissue cultures. Science 1968; 161(3846): 1145.
13. Tupkari S, Saoji A and Deshmukh V: Phytochemical study of *Solanum xanthocarpum*. Planta Med 1972; 22(06): 184-87.
14. Kusano G, Beisler J and Sato Y: Steroidal constituents of *S. xanthocarpum*. Phytochemistry 1973; 12(2): 397-01.
15. Parida P, Yadav RN, Shankar BR, Chakraborty DI, Das A and Singh NK: *In-silico* protein ligand interaction study of typical antipsychotic drugs against dopaminergic D2 receptor. Int J Phar Pharmceusci 2012; 5: 183-9.
16. Poongothai K, Ponmurugan P, Ahmed KSZ, Kumar BS and Sheriff SA: Antihyperglycemic and antioxidant effects of *Solanum xanthocarpum* leaves (field grown & in vitro raised) extracts on alloxan induced diabetic rats. Asian Journal of Tropical Medicine 2011; 4(10): 778-85.
17. Biswas TK and Mukherjee B: Wound healing potential of *Pterocarpus santalinus* L.; A pharmacological evaluation. Lower Extremity Wounds 2004; 3(3): 143-50.
18. Kumar N, Prakash D and Kumar P: Wound healing activity of *Solanum xanthocarpum* Schrad. & Wendl. fruits. Indian Journal of Natural Products and Resources 2010; 1(4): 470-75.
19. C RJ, RI and BJ P: Therapeutic potentials of Kantakari (*Solanum xanthocarpum* Schrad. & Wendl.). Ayurpharm Int J Ayur Alli Sci 2012; 1(2): 46-53.
20. Amol P, Arbar A and Deepti AK: Evaluation of bronchodilator effect of kantakari extract nebulisation in wheezing children: a randomized clinical study. International Journal of Research in Ayurveda & Pharmacy 2014; 5(3): 295-98.
21. Vadnere GP, Gaud RS and SinghaiAK: Evaluation of anti-asthmatic property of *Solanum xanthocarpum* flower extracts. Pharmacologyonline 2008; 1: 513-22.
22. D PD and C WG: Antibacterial, antioxidant and anti-inflammatory studies of leaves and roots of *Solanum xanthocarpum*. Unique Journal of Ayurvedic and Herbal Medicines 2013; 1(3): 59-63.
23. Anwikar S and Bhitre M: Study of the synergistic anti-inflammatory activity of *Solanum xanthocarpum* Schrad and Wendl and *Cassia fistula* Linn. International Journal of Ayurveda Research 2010; 1(3): 167-71.
24. Vinayaka K: Proximate Composition, Antibacterial and Anthelmintic Activity of Capsicum frutescens (L.) Var. Longa (Solanaceae) Leaves. Pharmacognosy Journal 2010; 2(12): 486-91.
25. Rajesh MR, Prashith TR, Avinash HC, Karthik KN, Ankkith GN and Raghavendra HL: Antimicrobial, insecticidal, and antiradical activity of *Solanum virginianum* Linn. (Solanaceae). Asian Journal of Pharmaceutical and Clinical Research 2017; 10(11): 163.
26. Singh KV and Bansal SK: Larvicidal properties of a perennial herb *Solanum xanthocarpum* against vectors of malaria and dengue/DHF. Curr Sci 2003; 84(6): 749-51.

27. Govindarajan M: Larvicidal and repellent properties of some essential oils against *Culex tritaeniorhynchus* Giles and *Anopheles subpictus* Grassi (Diptera: Culicidae). Asian Pacific Journal of Tropical Medicine 2011; 4(2): 106-11.
28. Mohan L, Sharma P and Srivastava CN: Evaluation of *Solanum xanthocarpum* extracts as mosquito larvicides. Journal of Environmental Biology 2005; 26(S-2): 399-01.
29. Najmi AK, Pillai KK, Pal SN and Aqil M: Free radical scavenging and hepatoprotective activity of jigrine against galactosamine induced hepatopathy in rats. Journal of Ethnopharmacology 2005; 97(3): 521-25.
30. Chaturvedi PK, Bhui K and Shukla Y: Lupeol: Connotations for chemoprevention. Cancer Letters 2008; 263(1): 1-13.
31. Siddique YH, Beg T and Afzal M: Anti-genotoxic effect of apigenin against anti-cancerous drugs. Toxicology *in-vitro*: An International Journal Published in Association with BIBRA 2008; 22(3): 625-31.
32. Kuo KW, Hsu SH, Li YP, Lin WL, Liu, LF, Chang LC and Sheu HM: Anticancer activity evaluation of the *Solanum* glycoalkaloid solamargine. Triggering apoptosis in human hepatoma cells. Biochemical Pharmacology 2000; 60(12): 1865-73.
33. Kumar S and Pandey AK. Chemistry and biological activities of flavonoids: An overview. The Scientific World Journal 2013; 1-16.
34. Mishra A, Kumar S, Bhargava A, Sharma B and Pandey AK: Studies on *in-vitro* antioxidant and antistaphylococcal activities of some important medicinal plants. Cellular and Molecular Biology (Noisy-Le-Grand, France) 2011; 57(1): 16-25.
35. Cavin A, Hostettmann K, Dyatmyko W and Potterat O: Antioxidant and lipophilic constituents of *Tinospora crispa*. Planta Medica 1998; 64(05): 393-96.
36. Kumar S, Gupta A and Pandey AK: *Calotropis procera* root extract has the capability to combat free radical-mediated damage. ISRN Pharmacology 2013; 1-8.
37. Jayaprakasha GK, Girennavar B and Patil BS: Radical scavenging activities of Rio Red grapefruits and Sour orange fruit extracts in different *in-vitro* model systems. Bioresource Technology 2008; 99(10): 4484–94.
38. Kumar S and Pandey AK: Medicinal attributes of *Solanum xanthocarpum* fruit consumed by several tribal communities as food: An *in-vitro* antioxidant, anticancer and anti-HIV perspective. BMC Complementary and Alternative Medicine 2014; 14(1): 1-8.

How to cite this article:
Mahmood A, Jurashe PS and Dash PR: Exploring the medicinal importance of *Solanum xanthocarpum*: A review. Int J Life Sci & Rev 2019; 5(7): 104-11. doi: 10.13040/IJPSR.0975-8232.IJLSR.5(7).104-11.