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Phytochemical estimations of volatile oil and crude extracts of *Solanum xanthocarpum* aerial parts

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ABSTRACT :

A close scrutiny of scientific reports available online about *Solanum xanthocarpum* aerial parts suggest that sporadic information is available only on selected plant species. The selected plant is well known for its traditional and medicinal uses. Considering the popularity, potential and lack of phytochemical estimations based research work on selected plant aerial parts. Therefore, present studies was planned to carry out various quantitative estimations in plants related to volatile oil, phenols, flavonoids, proteins and carbohydrates. Different extracts of plant aerial parts were set up by extracting plant material progressively utilizing viz., *n*-hexane, chloroform, methanol and water. *n*-Hexane extract showed presence of lipids; chloroform extract showed presence of alkaloids, steroids, triterpenoids; methanol extract showed presence of flavonoids, tannins, saponins, proteins, carbohydrates and water extract showed presence of saponins, proteins, carbohydrates. Volatile oil content of plant aerial parts was found to be 1.89 ± 0.01 % v/w. Refractive index and specific gravity of volatile oil of plant aerial parts were found to be 1.52 ± 0.03 and 0.79 ± 0.01 respectively. The mean estimations of quantitative test parameters viz., acid value, saponification value, ester value, hydroxyl value, iodine value, peroxide value, unsaponifiable matter and acetyl value of plant aerial parts were found to be 9.33 ± 0.01, 42.48 ± 0.02, 33.15 ± 0.01, 698.54 ± 0.05, 22.11 ± 0.03, 6.89 ± 0.01, 95.47 ± 0.03 and 72.44 ± 0.04 respectively. The observations of present investigations suggested that ethyl acetate fraction of plant aerial parts contained higher amount of total phenols (14.01 ± 0.30 % w/w) and flavonoids (6.89 ± 0.50 % w/w) than methanol extract and remaining methanol extract. The contents of total protein and carbohydrates in plant aerial parts were recorded to be 12.15 ± 0.145 and 32.89 ± 0.452% w/w respectively. The exhaustive survey of literature suggested that vast profile of pharmacological activities related to phenols and flavonoids. As plant aerial parts contained phenols and flavonoids as significant class of phytoconstituents, it is expected that various biological exercises of plant aerial parts might be credited to these constituents.

Keywords: *Solanum xanthocarpum*, phenols, flavonoids, monograph.

Introduction

The plant *Solanum xanthocarpum* Schrad & Wendl. (Solanaceae) is mainly known by Kantakaari in Ayurvedic system of medicine (API, 1989). The other botanical name of plant are *Solanum surattense* Burm.f., *Solanum virginianum* L. (Khare, 2004). A thorny diffuse dark green perennial spice, woody at the base, 2-3 m height, regularly found in Southeast Asia, Malaya and tropical Australia (Himalaya Health Care, 2002). It is widely distributed in India from coastline to slopes up to 1000 m high.

Traditionally the plant has been traditionally used in the treatment of various ailments such as fever, rheumatism, dropsy (Kirtikar et al., 1981), respiratory diseases (Govindan et al., 1999), bronchial asthma, chronic cough, tympanitis, misperistalsis, piles (Khare, 2004) and skin diseases (Mohagheghz-adeh et al., 2006).

The various types of natural pure compounds have been isolated from different parts of plant such as alkaloid (Aminuddin & Singh, 1982), flavanoid (Dubey & Gupta, 1978), Steriod (Heble et al., 1968); triterpenoid (Heble et al., 1971), sapogenin (Sato & Latham, 1953) and phenolic (Gupta & Dutta, 1936).

The various pharmacological actions of *S. xanthocarpum* have been reported as anti-inflammatory activity, antihistaminic activity (Parmar et al., 2008), anti-anaphylactic activity, anti-anaphylactic activity (Alai et al., 2008), wound healing activity (Dewangan et al., 2012), anti-asthmatic activity (Vadnere et al., 2008), anti-diabetic activity (Kar et al., 2006), immunomodulatory activity (Sultana et al., 2011), anti-ulcer activity (Bahuguna et al., 2008) and hepatoprotective activity (Gupta et al., 2011).

It is now possible to produce quality medicinal plant products in view of changing scenario towards utilization of medicinal plants coupled with newer techniques that are available for their chemical analysis. A large number of herbal and medicinal plants are available which have been

described in Ayurvedic texts for treatment of various health issues. The plant named *Solanum xanthocarpum* is one among the best of them. A close scrutiny of scientific reports available online about *Solanum xanthocarpum* aerial parts suggest that sporadic information is available only on selected plant species. The selected plant is well known for its traditional and medicinal uses. Considering the popularity, potential and lack of phytochemical estimations based research work on selected plant aerial parts. Therefore, present studies was planned to carry out various quantitative estimations in plants related to volatile oil, phenols, flavonoids, proteins and carbohydrates.

Materials and methods

Plant materials

Solanum xanthocarpum aerial parts were purchased form Nathimal Rugan Mal, Khari Baoli, Delhi, India in September, 2020. The authentication of the plant material was confirmed on the basis of literature reported and various photographic pictures available online.

Preparation of various extracts of *Solanum xanthocarpum* aerial parts

Solanum xanthocarpum aerial parts were dried under sunlight and powdered in a grinder. Dried powdered plant materials (100 g) were extracted and successively in a Soxhlet apparatus using solvents (500 ml each) in increasing order of polarity *viz., n*-hexane, chloroform and methanol. The marcs of plant were separately extracted with water (500 ml) on a hot plate for 2 h by decoction process to prepare water extract. Solvents and water from crude extracts were recovered under reduced pressure using rotary vacuum evaporator to get *n*-hexane extract (HE), chloroform extract (CE), methanol extract (ME) and water extract (WE). All extracts were subjected to phytochemical screening to detect different groups of phytoconstituents present (Farnsworth, 1966).

Volatile oil content of *Solanum xanthocarpum* aerial parts

The volatile oil content of *Solanum xanthocarpum* aerial parts was determined separately following the procedure given in USP/NF using Clevenger apparatus (USP/NF, 1990). The plant material (1 kg) was separately taken in a 1 L round bottom flask, to which 500 ml distilled water was added. The Clevenger apparatus was attached to the round bottom flask. The contents of the flask were boiled on a heating mantle, and the boiling was continued till whole of the volatile oil had distilled off. Volume of the volatile oil was noted. The experiment was performed in triplicate.

Various quantitative chemical tests *viz*., refractive index, specific gravity, acid value, saponification value, ester value, hydroxyl value, peroxide value, iodine value, unsaponifiable matter and acetyl value of the volatile oil of *Solanum xanthocarpum* aerial parts were done following the procedure given in Indian Pharmacopoeia. All the reagents, used in these tests, were prepared as per the procedure given in India Pharmacopoeia (IP, 1996). The experiments were performed in triplicate.

Estimation of total phenols content using Folin Ciocalteu's assay

The content of total phenols in *Solanum xanthocarpum* aerial parts was estimated following the standard procedure (Madaan et al., 2011).

Estimation of total flavonoids content using aluminium chloride assay

The content of total flavonoids in *Solanum xanthocarpum* aerial parts was estimated following the standard procedure (Madaan et al., 2011).

Estimation of proteins and carbohydrates

The content of total proteins and carbohydrates in *Solanum xanthocarpum* aerial parts was estimated following the standard procedures (Plummer, 1993).

Results and discussion

Examination of various extracts of *Solanum xanthocarpum* aerial parts

Different concentrates / extracts of *Solanum xanthocarpum* aerial parts were set up by extracting plant material progressively utilizing viz., *n*-hexane, chloroform, methanol and water. The yield of all different concentrates / extracts of *Solanum xanthocarpum* aerial parts as demonstrated in table 1.

Table 1: Yield of various extracts of *Solanum xanthocarpum* aerial parts.

Extract	Consistency	Colour	Yield (%w/w)
HE	Semi solid	Dark green	10.25
CE	Semi solid	Dark green	6.87
ME	Semi solid	Reddish brown	8.48

WE	Semi solid	Reddish brown	11.05.

Phytoconstituent investigations of *Solanum xanthocarpum* aerial parts

It is perquisite to subject rough concentrates for phytochemical screening to learn various classes of phytoconstituents prior to exposing them to estimate total phenols, flavonoids, proteins and carbohydrates content. Consequently, all unrefined concentrates of *Solanum xanthocarpum* aerial parts were evaluated for presence of various classes of phytoconstituents utilizing standard reagents. HE showed presence of lipids; CE showed presence of alkaloids, steroids, triterpenoids; ME showed presence of flavonoids, tannins, saponins, proteins, carbohydrates and WE showed presence of saponins, proteins, carbohydrates. The results of phytochemical screening are appeared in table 2.

Table 2: Phytoconstituent investigations of *Solanum xanthocarpum* aerial parts.

Class of phytoconstituents	HE	CE	ME	WE
Carbohydrates	-	-	+	+
Proteins / Amino acids	-	-	+	+
Lipids	+	-	-	-
Alkaloids	-	+	-	-
Anthraquinone glycosides	-	-	-	-
Cyanogenetic glycosides	-	-	-	-
Cardiac glycosides	-	-	-	-
Flavonoids	-	-	+	-
Saponins	-	-	+	+
Tannins	-	-	+	-
Steroids/Triterpenoids	-/-	+/+	-/-	-
Coumarins	-	-	-	-

+ : present, - : absent

Phytochemical estimations of volatile oil of *Solanum xanthocarpum* aerial parts

Medicinal and therapeutic importance of aromatic crude drugs is because of their volatile standards, i.e., unstable oils / essential oils / volatile oils. These medications are standardized based on their unstable oil content. Various quantitative chemical tests viz., acid value, iodine value, saponification value, ester value, unsaponifiable matter, acetyl value and volatile acidity are useful in the evaluation of fixed oils, resins, balsams, volatile oils and gums. Volatile oil content of *Solanum xanthocarpum* aerial parts was found to be 1.89 ± 0.01 % v/w. Refractive index and specific gravity of volatile oil of *Solanum xanthocarpum* aerial parts were found to be 1.52 ± 0.03 and 0.79 ± 0.01 respectively.

The observations of mean estimations of different quantitative compound boundaries viz., acid value, saponification value, ester value, hydroxyl value, iodine value, peroxide value, unsaponifiable matter and acetyl value of *Solanum xanthocarpum* aerial parts are introduced in table 3.

Table 3: Various quantitative chemical tests of volatile oil obtained from *Solanum xanthocarpum* aerial parts.

Parameter	Mean[n] value ± S.D.
Acid value	9.33 ± 0.01
Saponification value	42.48 ± 0.02
Ester value	33.15 ± 0.01
Hydroxyl value	698.54 ± 0.05
Iodine value	22.11 ± 0.03
Peroxide value	6.89 ± 0.01
Unsaponifiable matter	95.47 ± 0.03
Acetyl value	72.44 ± 0.04

n=3

Total phenols and flavonoids content of *Solanum xanthocarpum* aerial parts

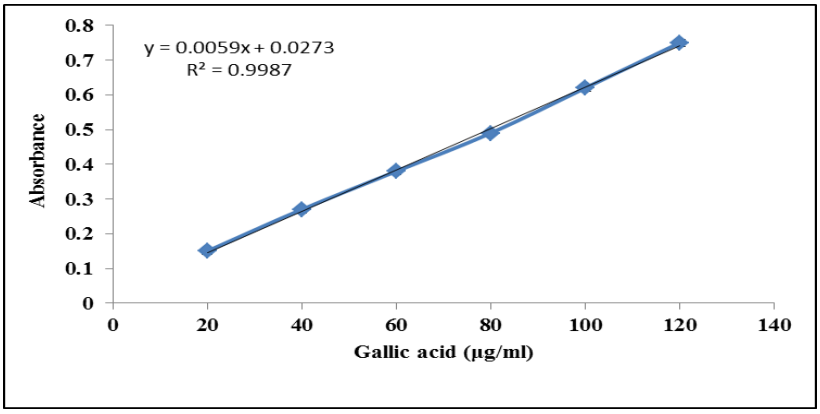
The *Solanum xanthocarpum* aerial parts were independently defatted by extracting with petroleum ether (60-80°C) by well-known extraction technology i.e. Soxhlet set up. The marc of plant was then independently extracted with methanol in a Soxhlet set up to acquire methanol extract (ME). As phenols and flavonoids are the significant class of phytoconstituents present in plant, consequently it was wanted to isolate phenol and flavonoid rich division from methanol extract of plant by standard methods. The yield of ME of was discovered to be 13.54 % w/w. The yield of ethyl acetate fraction of *Solanum xanthocarpum* aerial parts was discovered to be 25.31 % w/w (calculated on the basis of ME).

The research work for estimation of total phenols and total flavonoids was finished on the basis of a calibration plot of gallic acid (linearity: 20 to 120 µg/ml; $r^2 = 0.9987$) and quercetin (linearity: 30 to 180 µg/ml; $r^2 = 0.9997$) respectively. The observations of present investigations suggested that ethyl acetate fraction of *Solanum xanthocarpum* aerial parts contained higher amount of total phenols and flavonoids than methanol extract and remaining methanol extract. This finding suggested that that maximum amount of bioactive phenols and flavonoids in the methanol extract could be collected by extracted with ethyl acetate solvent. The results of the estimation of total phenols and total flavonoids in plant aerial parts are presented in table 4 and figure 1.

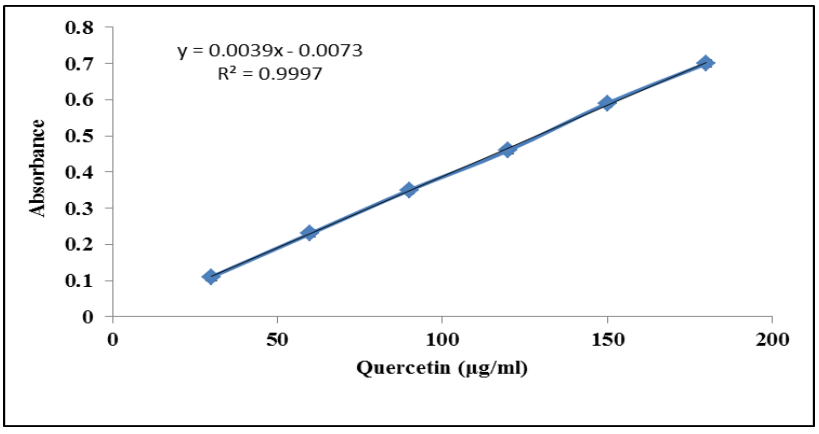
Table 4: Results of total phenols and flavonoids content in *Solanum xanthocarpum* aerial parts.

Plant material	Test sample	Total phenols content (% w/w) Mean^n ± S.D.	Total flavonoids content (% w/w) Mean^n ± S.D.
Solanum xanthocarpum aerial parts	ME	9.12 ± 0.10	3.45 ± 0.07
	EAF	14.01 ± 0.30	6.89 ± 0.50
	RME	1.64 ± 0.19	0.41 ± 0.01

n=3



(A)



(B)

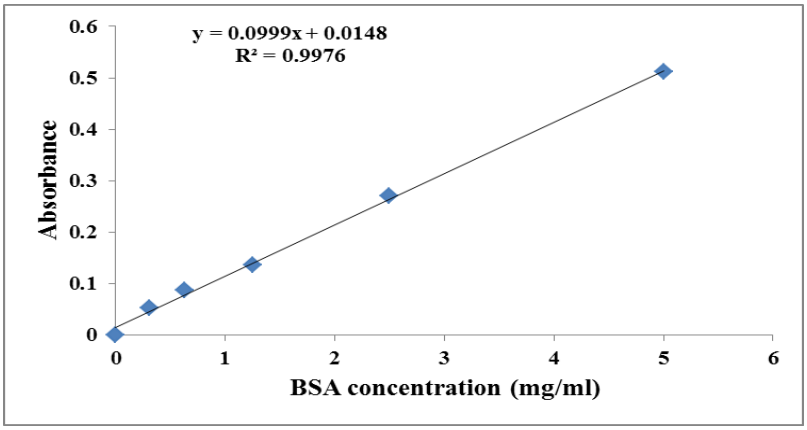
Figure 1: Calibration curve plots of (A) gallic acid vs absorbance; (B) quercetin vs absorbance.

Phenolic compounds are generally circulated regular cancer prevention agents (Skerget et al., 2005). Normally happening plant phenols and flavonoids have an expansive scope of pharmacological exercises like cancer prevention agent, antimutagenic, antimicrobial, antiulcer, antiarthritic, anticancer and protein kinase restraint (Marinova et al., 2005; Sulaiman and Balachandran, 2012). Free radicals have been found to assume

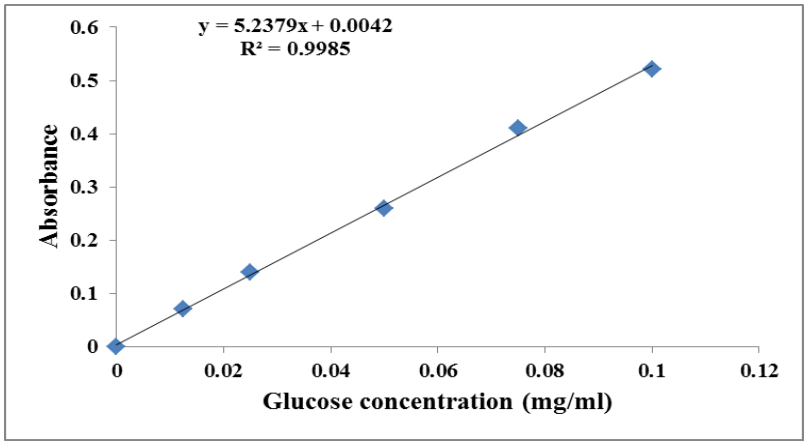
a significant part in a few human sicknesses including cerebrum problems (Haramoto et al., 2008), as mind is more helpless against oxidative pressure because of imbalance between reactive oxygen radicals and cell reinforcement guard arrangement of our body (Hotta et al., 2002). Comprehensive pharmacological work has been directed where phenolic and flavonoid compounds have been accounted for to have solid activity on CNS (Fernandez et al., 2006; Saaby et al., 2009; Viola et al., 1995) and various other pharmacological activities. The chosen plant in present investigations have long conventional of utilization in the treatment of different infirmities particularly in fever, joint pain, asthma type of issues, and the accessible writing uncovers that phenolic and flavonoid intensifies assume a urgent part in treating above mentioned infections. As *Solanum xanthocarpum* aerial parts contained phenols and flavonoids as significant class of phytoconstituents, it is expected that various biological exercises of *Solanum xanthocarpum* aerial parts might be credited to these constituents.

Total proteins and carbohydrates content of *Solanum xanthocarpum* aerial parts

The research work for estimation of proteins and carbohydrates content was finished on the basis of a calibration plot of bovine serum albumin (linearity: 0.3125 to 5 mg/ml; r^2 = 0.9976) and glucose (linearity: 0.0125 to 0.1 mg/ml; r^2 = 0.9985) respectively. The estimations of total protein and carbohydrates were made using regression equations of their respective standard plots. The quantitative determinations were carried out in triplicate, and the values were expressed in percent w/w (mean ± S.D.). The contents of total protein and carbohydrates in *Solanum xanthocarpum* aerial parts were recorded to be 12.15 ± 0.145 and 32.89 ± 0.452% w/w respectively. The calibration plots of bovine serum albumin and glucose for estimation of contents of total protein and carbohydrates in *Solanum xanthocarpum* aerial parts are presented in figure 2.



(A)



(B)

Figure 2: Calibration curve plots of (A) BSA vs absorbance; (B) Glucose vs absorbance.

Conclusion

The exhaustive survey of literature suggested that vast profile of pharmacological activities related to phenols and flavonoids. As *Solanum xanthocarpum* aerial parts contained phenols and flavonoids as significant class of phytoconstituents, it is expected that various biological exercises of *Solanum xanthocarpum* aerial parts might be credited to these constituents. Further, these compounds will be isolated form plant using column chromatography technology in future studies.

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