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Research Article

ANTIOXIDANT PROFILE AND GC-MS ANALYSIS OF *SOLANUM ERIANTHUM* LEAVES AND STEM- A COMPARISON

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ABSTRACT

Objective: *Solanum erianthum* (Solanaceae) is native to parts of Northern America and distributed throughout the Mediterranean basin. The present study was carried out to characterize the composition of some constituents, GC-MS analysis and antioxidant activities of *S.erianthum* leaves and stem.

Materials and Methods: Various solvent extracts (n-hexane, ethyl acetate, acetone, methanol) of both the parts were assessed for total content of phenolic, flavonoid, carbohydrate, protein contents, five different *in vitro* antioxidant assays viz. DPPH, superoxide, hydrogen peroxide- radical scavenging assays, Ferric reducing power activity (FRAP) and inhibition lipid peroxidation (TBARS) assay using standard phytochemical methods. GC-MS analyses were performed to identify the constituents present in the plant that stand behind such activities. Results: Ethyl acetate extract showed richer carbohydrate and protein contents in both leaves and stem. Whereas, in phenolic and flavonoid content, acetone extract was significant in leaves and methanol in stem. As expected, on the basis of the chemical analyses performed on the contents, *S.erianthum* leaves have shown to possess a better activity with respect to stem in all *in vitro* assays evidenced through the $SC_{50}/EC_{50}/IC_{50}$ values. By GC-MS analysis some important fatty acids were identified. This appeared to be responsible for such excellent antioxidant activity together with other unidentified compounds.

Conclusion: This work has contributed to clarify some particular characteristics of *S.erianthum* and the specific antioxidant power of leaves and stem. Hence, introduction of *S.erianthum* in therapeutics may be of undoubted utility to protect human health and well-being.

Keywords: *Solanum erianthum,* Antioxidant, Flavonoid, GC-MS, Phenolic.

INTRODUCTION

Humans around the globe probably discovered natural remedies against many diseases by trial and error over the millennia. For thousands of years, natural products have played a very important role in health care and prevention of diseases. Plants are vital source of antioxidants in nature as they contain numerous chemical compounds [1]. Despite the great successes already achieved in natural products chemistry and drug development, we have barely begun to tap the potential of our molecular diversity. A large study of literature indicates that substantial progress has been made concerning our knowledge of bioactive components in plant foods and their links to illnesses. The phenolic antioxidant compounds, have gained importance due to their large array of biological actions that include free radical scavenging, metal chelating and enzyme modulation activities [2]. However, the awareness is alive that the pool of natural products and the knowledge of traditional medicine are still important for the development of new drugs. Experiment evidence suggests that free radicals (FR) and reactive oxygen species (ROS) can be involved in a high number of adverse diseases [3,4]. As plants produce a lot of antioxidants to control the oxidative stress caused by sunbeams and oxygen, they can represent a source of new compounds with antioxidant activity. For developing a satisfactory antioxidant herbal formulation, there is a need to evaluate the formulation for desired properties such as antioxidant activity.

Solanum erianthum is a species of night shade belonging to the family Solanaceae, native to North America and Northern South America. Commonly known as 'Potato tree', a fast growing evergreen shrub has considerable pharmacological applications. Leaves were considered to treat leucorrhea, malaria, leprosy, haemmorrhoids, vertigo scrofula, to induce abortion, as an analgesic etc [5]. Root decoctions were used to treat dysentery, fever, diarrhea, digestive problems, violent body pains, arthritis etc, as an anti-malarial, anticholinergic, anti-inflammatory agent etc [6,7]. The primary objective of the present investigation is to evaluate the antioxidant property of *Solanum erianthum* leaves and stem extracts, which would open-up a new door for the utility of common plants, yet under-utilized as a therapeutic agent. The meticulous aim of the present investigation is to figure out the chemical composition and pharmacological activities of its components. The use of more than one standard method to evaluate the antioxidant power of the plant is mandatory, hence performed with renovating interest.

MATERIALS AND METHODS

Plant selection and authentification

Fresh, healthy leaves and stem of *Solanum erianthum* were collected during November month in Lousiana Estates, Nilgris, Tamil Nadu. At the time of collection, a pressed specimen was prepared and authenticated by a Taxonomist [BSI/SRC/5/23/23/2010-11/Tech-1480], BSI-Southern Circle, TNAU, Coimbatore.

Extraction procedure

The air-dried, powdered leaf and stem samples were deprived of dusts and insects, subjected to soxhelation using each of the following solvents in increasing polarity: *n*-hexane (HX), ethyl acetate (EA), acetone (AC) and methanol (ME). Then the solvent was distilled off, till the extract turns off into a syrupy consistency. All the crude solvent extracts were stored at 4–5°C until further use.

Phytochemical screening

All the crude extracts of *S.erianthum* were diluted in their respective solvents and subjected for qualitative preliminary phytochemical screening to identify the presence of the secondary metabolites according to the standard methods [8]. From the intensity of the color inferred for the tests, they were rated for their presence.

Estimation of phenolic content

Contents of total phenolics in the extracts were estimated by a colorimetric assay based on standard procedures [9]. Basically, 1 ml of sample was mixed with 1ml of Folin and Ciocalteu's phenol reagent. After 3 min, 1 ml of saturated sodium carbonate solution was added to the mixture and it was made upto 10 ml with distilled water. The reaction was kept in the dark for 90 min, after which the absorbance was read at 725 nm (Analytik Jena 200–2004 spectrophotometer). Gallic acid was used for constructing the standard curve (0.01–0.4 mM; $y = 2.94848 x - 0.09211$; $R^2 = 0.99914$) and the results were expressed as µg of gallic acid equivalents (GAEs) per mg of extract.

Estimation of flavonoid content

Flavonoid contents in the extracts were determined by a colorimetric method [9]. The flower extract (250 µL) was mixed with 1.25 ml of distilled water and 75 µL of a 5% $NaNO_2$ solution. After 5 min, 150 µL of 10% $AlCl_3.H_2O$ solution was added. After 6 min, 500 µL of 1 M NaOH and 275 µL of distilled water were added to prepare the mixture. The solution was mixed well and the absorbance was read at 510 nm. (+)-Catechin was used to calculate the standard curve (0.250–2.500 mM; Y = 0.2903; R^2 = 1.0000) and the results were expressed as µg of (+)-catechin equivalents (CEs) per mg of extract.

Estimation of carbohydrate content

Total carbohydrate contents were estimated by anthrone method [10]. Glucose was used to calculate the standard curve (20-120 µg/ml, Y= 0.0263x+0.0532, R^2= 0.9992) and the results were expressed has µg of glucose equivalents (GEs) per mg of extract.

Estimation of protein content

Total proteins were estimated by Lowry's method [11]. Bovine serum albumin was used to calculate the standard curve (20-160 µg/ml, Y = 0.0159x + 0.0319, R^2 = 0.9569) and the results were expressed as µg of bovine serum albumin equivalents (BSAEs) per mg of extract.

DPPH- radical scavenging activity

Various concentrations of *S.erianthum* leaf and stem extracts (0.3 ml) were mixed with 2.7 ml of methanol solution containing DPPH radicals (6 x 10^{-5} mol/l). The mixture was shaken vigorously and left to stand for 60 min in the dark (until stable absorbance values were obtained). The reduction of the DPPH radical was determined by reading the absorbance at 517 nm. The radical scavenging activity (RSA) was calculated as a percentage of DPPH discoloration, using the equation: %RSA= $[(A_{DPPH} - A_S)/A_{DPPH}]$ x 100, where A_S is the absorbance of the solution when the sample extract is added at a particular level and A_{DPPH} is the absorbance of the DPPH solution [9]. Ascorbic acid was used as a standard.

Superoxide anion radical scavenging assay

The assay for superoxide anion radical scavenging activity was based on a riboflavin – light –NBT system [12]. The reaction mixture contain 0.5 ml of phosphate buffer (50 mM- pH-7.6), 0.3 ml riboflavin (50 mM), 0.25 ml PMS (20 mM), 0.1 ml NBT (0.5 mM), prior to the addition of 1 ml sample solution at varying concentrations (25-250 µg/ml). Reaction was started by illuminating the reaction mixture with different concentrations of the methanol extracts using a fluorescent lamp. After 20 min of incubation, the absorbance was measured at 560 nm. Ascorbic acid was used as standard. The percent inhibition of superoxide anion generation was calculated using the following formula:

$$\text{Scavenging activity (\%)} = \frac{\text{1- absorbance of sample x 100}}{\text{absorbance of control}}$$

Hydrogen peroxide scavenging assay

The ability of the extracts to scavenge hydrogen peroxide was determined according to the standard method [13]. A solution of hydrogen peroxide (2 mM) was prepared in 50 mM phosphate buffer (pH 7.4). Aliquots (0.1 ml) of the extracted samples were transferred into the test tubes and their volumes were made upto 0.4 ml with 50 mM phosphate buffer (pH 7.4). After addition of 0.6 ml hydrogen peroxide solution, tubes were vortexed and absorbance of the hydrogen peroxide at 230 nm was determined after 10 min, against the blank. The abilities to scavenge the hydrogen peroxide were calculated using the following equation:

$$\text{Hydrogen peroxide scavenging activity} = \frac{\text{1- absorbance of sample x 100}}{\text{absorbance of control}}$$

Ferric reducing power assay

Various concentrations of *S.erianthum* extracts (2.5 ml) were mixed with 2.5 ml of 200 mM sodium phosphate buffer (pH 6.6) and 2.5 ml of 1% potassium ferricyanide. The mixture was incubated at 50 ˚C for 20 min. After 2.5 ml of 10% trichloroacetic acid (w/v) was added, the mixture was centrifuged at 1000 rpm for 8 min (Centorion K24OR-2003 refrigerated centrifuge). The upper layer (5 ml) was mixed with 5 ml of deionised water and 1 ml of 0.1% of ferric chloride, and the absorbance was measured spectrophotometrically at 700 nm [14]. Ascorbic acid was used as a standard.

Inhibition of lipid peroxidation using thiobarbituric acid reactive substances (TBARS)

The procedure using a Fenton reaction-induced lipid peroxidation has been adapted for this assay [15]. The extracts of all species in concentration of 100 µg/ml have been mixed with 300 µL Tris- HCl buffer, pH=7.5, 500 µL of 20 mM linoleic acid and 100 µL of 4 mM $FeSO_4$. The peroxidation was started with the addition of 100 µL of 5 mM ascorbic acid. The reaction mixture was incubated for 60 min at 37°C. Thereafter, 2 ml of 10% ice cold trichloroacetic acid was added and 1 ml aliquot of the samples was added with 1 ml of thiobarbituric acid. The TBA/sample mixture was heated in the water bath at 95°C for another 60 min. the absorbance was read at 532 nm and the percentage of linoleic acid peroxidation inhibition was calculated using appropriate controls. Ascorbic acid was used as positive control.

Antibacterial activity

Media Used (Nutrient broth): Peptone-10 g, NaCl-10 g and Yeast extract 5 g, Agar 20 g in 1000 ml of distilled water. Initially, the stock cultures of bacteria were revived by inoculating in broth media and grown at 37ºC for 18 h. The agar plates of the above media were prepared and wells were made in the plate. Each plate was inoculated with 18 h old cultures (100 µL, 10^4 cfu) and spread evenly on the plate. After 20 min, the wells were filled with different concentrations of samples. The control wells were filled with 'Gentamycin' along with solvents. All the plates were incubated at 37ºC for 24 h and the diameter of inhibition zones were noted. The assay [16] was repeated twice and the mean of the three experiments were recorded.

GC-MS analysis

GC-MS was performed with GC Clarus 500 Perkin Elmer equipment; conditions modified from a method published by Frankel et al., [17]. Compounds were separated on a 30 m x 0.25 mm capillary column coated with a 0.2 µm film of HP-5-MS. Samples were injected with a split ratio of 50:1; helium was used as carrier gas at 1 ml/min. The column temperature was maintained at 100°C for 1 min after injection then increased at 10°C/min to 275°C which was sustained for 20 min. The time required for chromatography of one sample was 36 min.

Statistical analysis

All the experiments were carried out in triplets and the results are expressed as mean values and standard error or standard deviation (SD).

RESULTS AND DISCUSSION

There is a great interest in the use of antioxidants that intercept ROS to ameliorate oxidative stress induced diseases. Many different antioxidant components are present as laid in Table 1 and it is relatively worth to measure their capacity using *in vitro* system. Moreover their mode of presence has been recorded from intensely present to moderately present. This has influenced to quantify their amounts in the plant extracts of both the parts.

Significant TPC were produced by acetone (0.667 mg) extract of leaves and methanol (0.606 mg) extract of stem. It should be highly appreciable that about 60% of the TPC have been extracted by acetone extract of leaves from 2 mg of crude. By this way it can be assumed the phenolic composition of the leaves. On the other hand, hexane has recorded least contents in both the parts as given in Table 2. Likewise TFC has been found to be greater in acetone extract (0.574 mg) of leaves compared to methanol extract (0.522 mg) of stem, followed by ethyl acetate extract (0.514 mg) of leaves and acetone extract (0.506 mg) of stem. It can be preferably noted

that leaves has ample efficiency to support the antioxidant assays compared to stem, irrespective of their crude extracts. According to reports [18], a highly positive relationship between TPC and antioxidant activity appears to be the trend in many plant species.

Table 1: Preliminary qualitative screening of *Solanum erianthum* extracts

Constituents	Name of the test	*Solanum erianthum*							
		Leaves				Stem			
		HX	EA	AC	ME	HX	EA	AC	ME
Alkaloids	Wagner's	++-	+--	+--	++-	---	++-	+--	+--
	Meyer's	+--	++-	+--	+--	+++	++-	++-	+--
	Dragendroff's	---	+--	--	+--	+--	+--	+--	+--
	Shinoda's	---	++-	++-	+++	+--	+--	---	---
Flavonoids	Alkaline	+--	+++	+++	+++	---	++-	++-	++-
	Con.H_2SO_4	++-	++-	++-	++-	++-	++-	++-	+++
Phenolics	$Fecl_3$	---	++-	+++	++-	---	+--	++-	+++
	Dichromate	---	++-	+++	++-	---	+--	++-	++-
	Lead acetate	---	---	+--	+--	---	+--	+--	++-
Tannins	Gelatin	++-	---	---	+--	---	+--	+--	---
	KOH	+--	---	++--	+--	---	---	---	---
Saponins	Foam	++-	+--	+--	+--	---	---	+--	+--
Carbohydrate	Molisch's	+++	+++	+--	+--	+++	++-	++-	++-
	Fehling's	+++	++-	++-	++-	+++	++-	++-	+--
	Barfoed's	+++	+++	+++	+--	+++	+--	+++	+--
	Borntrager's	++-	+++	+--	++-	++-	+--	+++	+++
Proteins	Biuret	+++	+++	++-	+--	++-	+++	+++	+--
	Ninhydrin	+++	+++	+++	+--	+++	++-	+--	+--
Steroids	Libermann's	+--	+--	+--	+--	+---	+---	+---	+---
	Salkowski's	+++	---	---	+--	+--	+--	+--	---
Terpenoids	Hager's	+++	+++	+++	++-	+++	++-	+--	+--
Glycosides	Keller-killiani	+++	++-	++-	+--	+++	++-	+--	+--
Fats /Oils	Biuret's	+++	+++	+++	+--	+++	+++	++-	+--

HX-hexane; EA-ethyl acetate; AC-acetone; ME-methanol

Table 2: Estimation of phenolic, flavonoid, carbohydrate and protein content

Contents (µg/mL)	Leaves				Stem			
	HX	EA	AC	ME	HX	EA	AC	ME
Total phenolic	42.8	65.3	66.7	58.3	42.8	51.3	55.9	60.6
Total flavonoid	48.2	51.4	57.4	48.8	40.2	47.1	50.6	52.2
Carbohydrate	66.1	138.6	102.2	86.6	59.1	100.6	73.2	71.1
Protein	71.7	100.5	89.7	81.6	72.8	92.5	91.7	81.6

HX-hexane; EA-ethyl acetate; AC-acetone; ME-methanol

For carbohydrate content, in both leaves and stem, ethyl acetate extract rendered its significance of about 1.380 mg and 1.006 mg. For instance, acetone and methanol recorded less intense contents ie., 1.020 mg , 0.886 mg for leaves and 0.732 mg, 0.711 mg for stem respectively. Among which, leaves has given great impact as given in Table 2. Aligned with carbohydrate content, in protein content, ethyl acetate seemed to record richer contents (1.005 mg for leaves and 0.925 mg for stem) compared to other extracts, with respect to the individual parts. Hexane extract provided a very least protein contents of about 0.778 mg for stem and 0.717 mg for leaves.

The results of TPC, TFC, carbohydrate and protein contents are likely to be responsible for the free radical scavenging capacities of the plant extracts. But there were no uniformity between the extracts in recording their significance in all these contents. Whatsoever, the TPC and TFC can be considered to be important for the antioxidant properties. The reason behind this must be the polarity of the solvents extracting the constituents matching to its polarity range.

There was found a neat scavenging effect (Figure 1) of almost all the extracts on DPPH radicals which was observed by the decrease in absorption with the increase in concentration, at 517 nm. Except the hexane extract of stem, all the other extracts exhibited the %RSA above 50%. SC_{50} values for the extracts [50% scavenging capacity] calculated against the standard ascorbic acid (0.125 mg) displayed the specific inhibition of *S.erianthum* against the free radicals. Leaves scavenged DPPH very efficiently compared to stem, especially its acetone extract [SC_{50}= 0.156 mg]. It produced a maximum inhibition around 88% whereas the acetone extract of stem produced 81%, for a note. But methanol extract of stem has recorded good scavenging activities of about 0.176 mg. On the other hand, ethyl acetate extracts of both leaves and stem also recorded fine scavenging activities [SC_{50}=1.122 mg for leaves, SC_{50}=1.86 mg for stem].

In superoxide scavenging assay excellent activities were observed in *S.erianthum* as shown in Figure 2. At the least concentration of 50 mg/ml, the %RSA of ascorbic acid was found to be 70.8% while that of the acetone extract of leaves was 52.3% and methanol extract of stem was 59.8%, thus being significant. On the other hand, at the highest concentration of 250 mg/ml, the RSA were 89.2% for ascorbic acid, 67.7% for acetone extract of leaves and 66.2% for methanol extract of stem. Moreover, except hexane extracts of both parts, the SC_{50} values were recorded for all the extracts. Their SC_{50} value are shown in Table 3, among which the significance was presented by the ascorbic acid [SC_{50}= 20.2 mg] obviously. Acetone and methanol extract of stem and leaves showed its next best activity respectively.

As shown in Figure 3, various crude fractions exhibited a concentration-dependant inhibition of the hydrogen peroxide radical scavenging activity. A maximum of 91% inhibition was obtained at 250 mg/ml of the ascorbic acid, 66.6% by acetone

extract of leaves and 68.1% by methanol extract of stem. This scavenging activity was statistically significant when compared to that without any inhibitor. Among the various concentrations tested, acetone extract of leaves showed maximum %RSA at 250 mg/ml and at least concentration of 50 mg/ml it was 58.5%. Methanol and acetone extracts of stem and leaves played good scavenging role, exhibiting SC_{50} values of about 42.09 mg and 43.03 mg respectively. It was surprising to record the hexane extract showed satisfactory % RSA but less than 50%, with reference to the standard.

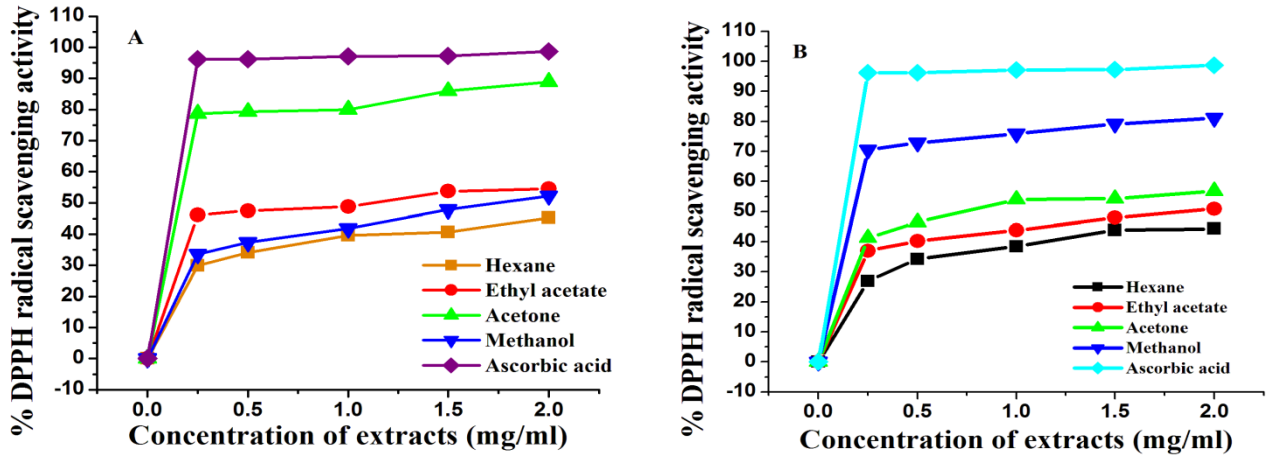

Fig. 1: DPPH radical scavenging activity leaf (A) and stem (B) extracts

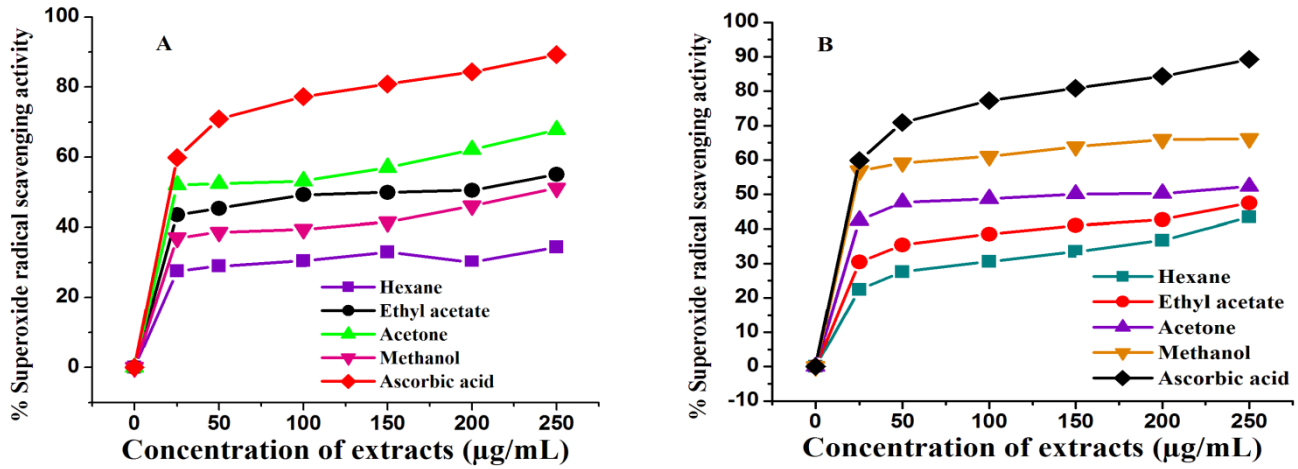

Fig. 2: Superoxide anion radical scavenging activity leaf (A) and stem (B) extracts

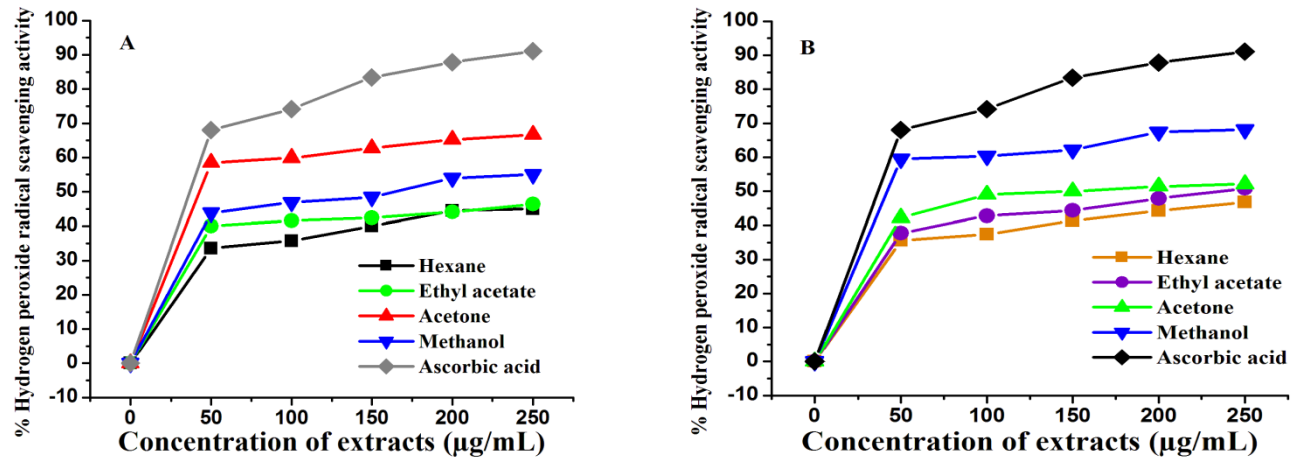

Fig. 3: Hydrogen peroxide radical scavenging activity leaf (A) and stem (B) extracts

Table 3: *In vitro* antioxidant assays of *Solanum erianthum*

SC_{50}/ EC_{50}/ IC_{50}	Leaves				Stem			
	HX	EA	AC	ME	HX	EA	AC	ME
DPPH-scavenging activity	-	1.122	0.156	1.746	-	1.861	0.74	0.176
Hydrogen peroxide scavenging activity	-	-	43.03	165.08	-	238.71	155.48	42.09
Superoxide scavenging activity	-	160.68	24.48	240.58	-	-	149.41	22.62
Reducing power Activity	0.954	0.178	0.112	0.159	-	0.939	0.216	0.167
Inhibition of lipid peroxidation (TBARS)	-	-	0.136	0.61	-	0.195	0.173	0.157

HX-hexane; EA-ethyl acetate; AC-acetone; ME-methanol

From the Figure 4, it can be inferred that the acetone extract of leaves and methanol extract of stem exhibited a maximum reducing power being in a concentration- dependant manner. As the concentration of extracts increased from 0.2 to 1.2 mg/ml, the reducing power at 700 nm, the EC_{50} value of various extracts obtained were 0.159 mg for methanol, 0.178 mg for ethyl acetate, 0.112 mg for acetone, 0.954 mg for hexane in leaves and 0.167 mg for methanol, 0.939 mg for ethyl acetate, 0.216 mg for acetone in stem. Interestingly, as seen in Figure 4, it can be inferred a neat and steady increase of activity with concentration can be clarified for deeper understanding.

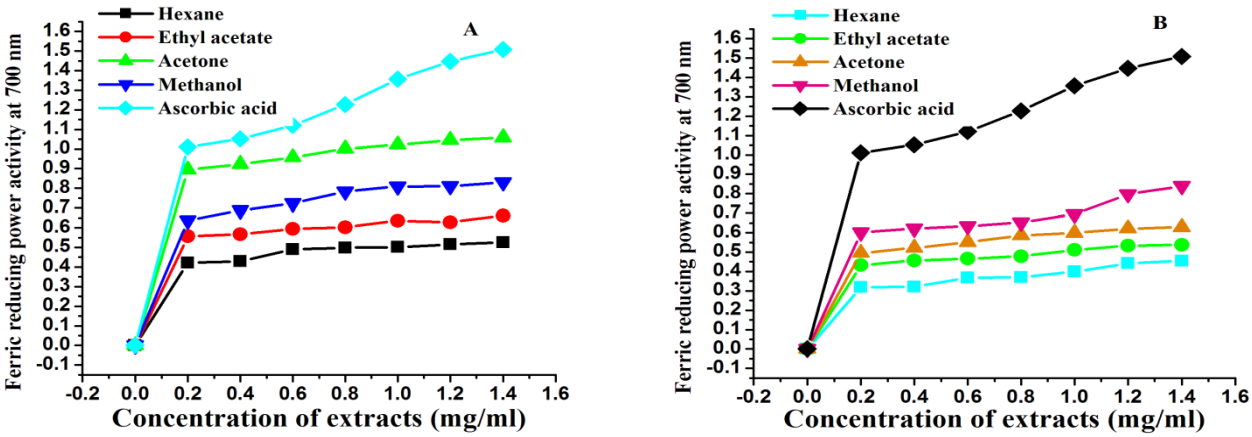

Fig. 4: Reducing power activity leaf (A) and stem (B) extracts

In lipid peroxidation assay, various crude extracts of both leaves and stem exhibited a concentration- dependant inhibition [Figure 5] of $FeSO_4$ and ascorbate induced lipid peroxidation. A maximum concentration of 1 mg/ml of acetone extract of leaves and methanol extract of stem significantly inhibited the lipid peroxidation to a maximum of 73.9% and 73.7% respectively. For instance, the overall increasing magnitude of antioxidant potential [IC_{50}] of all the extracts in modulating lipid peroxidation were obtained as follows: acetone of leaves (0.136 mg)> ascorbic acid (0.15 mg)> methanol of stem (0.157 mg)> methanol of leaves (0.61 mg)> acetone of leaves (0.173 mg)> ethyl acetate of stem (0.195 mg).

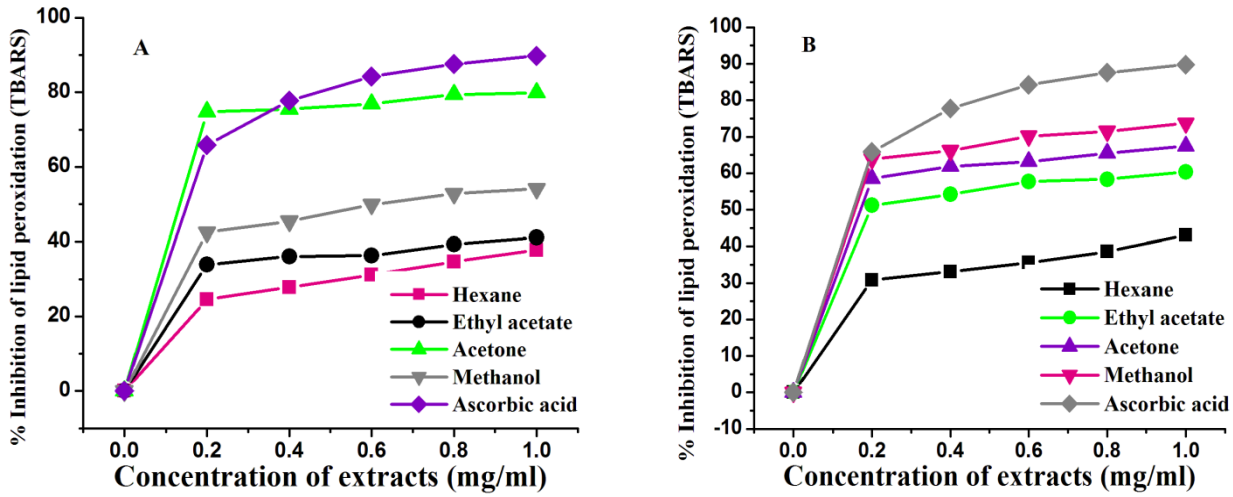

Fig. 5: Inhibition of lipid peroxidation (TBARS) leaf (A) and stem (B) extract

Table 4 has listed the constituents identified from GC-MS analysis. It was highly convincing that compounds like phytol [RT-14.39], sorbitol [RT-26.27], glucose [RT-26.03], dotrioctane [RT-21.81], hexadecanoic acid [RT-12.82] in addition to many other fatty acids were identified in *Solanum erianthum*. Polyunsaturated fatty acids are major constituents of erythrocyte membranes and are vulnerable to free radical attack [19]. Moreover there were some constituents found to be common in both the parts. The phenolic constituent 'phytol' present in leaves can be ascribed to be the reason behind its excellent antioxidant property in contrast to stem.

Table 4a: Constituents identified by GC-MS analysis of *Solanum erianthum* seeds

S. No.	RT	Class of the compounds	Name of the compound	Molecular formula	MW	Peak Area %
1	11.21	Terpene alcohol	3,7,11,15-Tetramethyl-2-Hexadecen-1-ol	$C_{20}H_{40}O$	296	7.7
2	12.82	Palmitic acid	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	41.0
3	12.99	Fatty acid	Pentadecanoic acid, 2,6,10,14-tetramethyl, methyl ester	$C_{20}H_{40}O_2$	312	41.0
4	15.08	Fatty acid	Octanoic acid	$C_8H_{16}O_2$	144	20.9
5	20.26	Plasticizer compound	1,2, Benzene dicarboxylic acid, diisooctyl ester	$C_{24}H_{38}O_4$	390	10.3
6	25.72	Carbohydrate	Mannose	$C_6H_{12}O_6$	180	16.3
7	26.28	Sugar alcohol	Sorbitol	$C_6H_{14}O_6$	182	15.5
8	30.17	Fatty acid	Oleic acid	$C_{18}H_{34}O_2$	282	18.2

Table 4b: Constituents identified by GC-MS analysis of *Solanum erianthum* leaves

S. No.	RT	Class of the compounds	Name of the Compound	Molecular formula	MW	Peak Area %
1	8.53	Carboxylic acid	Acetic acid	$C_2H_4O_2$	60	9.7
2	11.03	Mineral acid	Phosphoric acid	H_3PO_4	98	6.6
3	11.15	Carboxylic acid	3,7,11,15-Tetramethyl-2-Hexadecen-1-ol	$C_{20}H_{40}O$	296	13.3
4	12.73	Palmitic acid	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	20.0
5	12.92	Fatty acids	Pentadecanoic acid, 2,6,10,14-tetramethyl-, methyl ester	$C_{20}H_{40}O_2$	312	20.0
6	14.39	Diterpene	Phytol	$C_{20}H_{40}O$	296	46.7
7	15.01	Linoleic acid	Octanoic acid	$C_8H_{16}O_2$	14	17.8
8	17.99	Dicarboxylic acid	Malic acid	$C_4H_6O_5$	134	13.6
9	20.16	Sugar acid	Xylonic acid	$C_5H_{10}O_6$	166	11.3
10	21.81	Hydrocarbon	Octane	C8H18	114	11.6
11	30.11	Stearic acid	Octadecanoic acid	$C_{18}H_{32}O_2$	280	15.4
12	35.07	Sugar units	α-D-gluco pyranoside	$C_7H_{14}O_6$	194	12.8

Comprehensively, leaves have dominated in TPC, carbohydrate, protein content and stem in TFC, with respect to the solvent extracts. But it can be noted from the results that there were no vast difference between the contents as far as both the parts are concerned. It should be appreciated that there was a record of privileged contents present in whole of the 2 mg plant extract. In addition, the *in vitro* antioxidant assays has provided a hallmark efficiency of *S.erianthum* parts, especially leaves. Coming to the role of the solvents, next to acetone and methanol, ethyl acetate has presented its significance in both the parts.

CONCLUSION

S.erianthum leaves and stem have proved that they have served as a reservoir of phenolics, flavonoids, carbohydrates and proteins. The overall antioxidant activity of their extracts might be attributed to the presence of those phytochemical constituents. Leaves have proved its high efficiency compared to stem and thereby it can be used as a potent therapeutic agent. This study highlights the need for further research on the isolation and characterization of the constituents from extracts in order to decode the specific phytochemical constituent(s) responsible for the antioxidant activity of the plant.

ABBREVIATIONS

1,1-diphenyl,2-picryl hydrazyl [DPPH], nitroblue tetrazolium [NBT], 50% capacity of the extract to inhibit the radicals [IC_{50}], 50% scavenging capacity of the extract [SC_{50}], 50% efficient concentration of the extract to donate electrons [EC_{50}], radical scavenging activity [RSA], total phenolic content [TPC], total flavonoid content [TFC], retention time [RT].

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