GC-MS Study on the Bioactive Components and Anti-Cancer Activities of *Solanum surattense*

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Abstract: Ayurveda is a 5000 year-old system of natural healing that has its origins in the Vedic culture of India. In the last few decades there has been an exponential growth in the field of herbal medicine. Medicinal plants and herbs contain substances known to modern and ancient civilizations for their healing properties. They were the sole source of active principles capable of curing man's ailments. Thus natural products have been a major source of drugs for centuries. *Solanum surattense*, is such a medicinally important plant of family Solanaceae. All parts of the tree have medicinal properties. Taking into consideration the medicinal importance of the plant, the volatile organic matter from the bark of this plant was analyzed for the first time using GC-MS and the structures were confirmed by genesis. The majority of prevailing constitutents in this plant, trans-Squalene (31.55%), 9,12,15-Octadecatrienoic acid, (Z,Z,Z)- (10.20%), Phytol (8.17%) and Vitamin E (7.86%) are proven anti-Cancer agents.
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Key words: *Solanum surattense,* GC-MS, Bioactive components, Biological Activity

Introduction

Plants have been an important source of medicine for thousands of years. The rich resource is decreasing at an alarming rate as a result of over-exploitation. The medicinal value of drug plants is due to the presence of some chemical substances in the plant tissues which produce a definite physiological action on the human body. These chemicals include alkaloids, flavanoids, glucosides, tannins, gums, resins, essential oils, fatty oils, carbon compounds, hydrogen, oxygen, nitrogen salts of some chemicals, etc. Very few of these chemicals are toxic also. Hence, preparation and administration of drugs should be done by experts only. Drugs may be obtained from various parts of the plant. So, an extensive study is required to detect the medical properties of the plant. Several medicinal plants have been tried against pathogenic microorganisms [1]

Solanaceae is a large plant family containing two thousand and three hundred species, nearly half of which belong to a single genus, Solanum. There are herbs, shrubs or small trees under this genus. This family comprises a number of plants widely known for the presence of variety of natural products of medicinal significance. Crude plant extract is beneficial in bronchial asthma and non-specific cough, influenza, difficult urination, bladder stones, rheumatism, etc.

Medicinal plants are of great importance to the health of individuals and communities. The extensive use of natural plant as primary health remedies due to their pharmacological properties is quite common [2]. Plants are used medicinally in different countries and are a source of many potent and powerful drugs [3].The investigation of the efficacy of plant-based drugs has been paid great attention because of their few side effects, cheap and easy availability [4].According to the world health organization 80% of the world population still relies mainly on plants drugs. Resistance to antibiotics has been the reason of research for newer drugs to treat microbial infections [5].The medicinal value of these plants lies in some chemical substances that produce a definite physiological action on the human body. The most important of these bioactive constituents of plants are alkaloids, tannins, flavonoids, and phenolic compounds [6]. *Solanum surattense* belongs to family Solanaceae. It is a commonly growing perennial herbaceous weed. It is commonly known as Indian night shade or yellow berried night shade has been used traditionally for curing various ailments such as fever, cough, asthma and diabetes in South Indian traditional medicines [7]. The anti diabetic potential of the fruit was studied in diabetic rats [8,9]. The ethanol and methanol extracts of *Solanum surattense* showed strong antibacterial activity against *Pseudomonas aeruginosa* [10]. The present studies were carried out to screen the phytochemical constituents and to test the antifungal efficacy of the seed extracts of *Solanum surattense* with reference to fungal spp. *Solanum surattense* have also proved to be showing antibacterial [11] and antifungal activities. [12]

Materials and Methods

Plant material and extraction procedure

Leaves of *Solanum surattense* were bought fresh from local market, Thanjavur. 10gm powdered plant material was soaked in 20ml of Absolute alcohol overnight and then filtered through a Whatman® No. 41 filter paper (pore size 20 - 25_m) along with 2gm Sodium sulfate to remove the sediments and traces of water in the filtrate. Before filtering, the filter paper along with sodium sulphate was wetted with absolute alcohol. The filtrate is then concentrated by bubbling nitrogen gas into the solution and was concentrated to 1ml. The extract contains both polar and non-polar phytocomponents.

Gas Chromatography–Mass Spectrometry (GC/MS) analysis

GC/MS analysis of this extract was performed using a Perkin Elmer GC Claurus 500 system and Gas Chromatograph interfaced to a Mass Spectrometer (GC/MS) equipped with a Elite-1 fused silica capillary column (30 m × 0.25 mm ID. ×1 µMdf, composed of 100% Dimethyl poly siloxane). For GC/MS detection, an electron ionization system with ionization energy of 70 eV was used. Helium gas (99.999%) was used as the carrier gas at a constant flow rate of 1 ml/min. and an injection volume of 2 µl was employed (split ratio of 10:1). Injector temperature 250°C; Ion-source temperature 280°C. The oven temperature was programmed from 110°C (isothermal for 2 min.), with an increase of 10°C/min, to 200°C, then 5°C/min to 280°C, ending with a 9 min. isothermal at 280°C. Mass spectra were taken at 70 eV; a scan interval of 0.5 seconds and fragments from 45 to 450 Da. Total GC running time was 36 min.The relative percentage amount of each component was calculated by comparing its average peak area to the total areas. Software adopted to handle mass spectra and chromatograms was a TurboMass Ver5.2.0

Results and Discussion

Identification of Components

Interpretation on mass spectrum GC-MS was conducted using the database of National Institute Standard and Technology (NIST) having more than 62,000 patterns. The spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The Name, Molecular weight and Structure of the components of the test materials were ascertained.

Seventeen compounds were identified in *Solanum surattese* leaf extract by GC-MS analysis .The active principles with their Retention time (RT), Molecular formula, Molecular weight (MW) and Concentration (%) are presented in (Table 1 and Fig 1).The prevailing compounds were trans-Squalene (31.55%), n-Hexadecanoic acid (13.30%) and 9,12,15-Octadecatrienoic acid, (Z,Z,Z)- (10.20%).

The biological activities listed are based on Dr. Duke's Phytochemical and Ethnobotanical Databases by Dr. Jim Duke of the Agricultural Research Service/USDA.

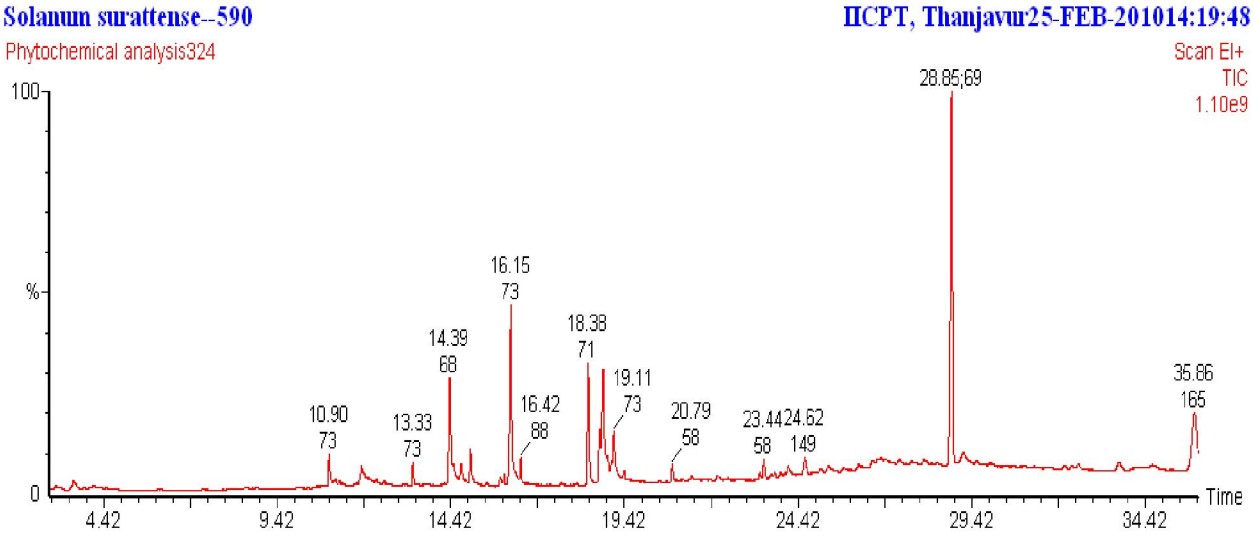

Figure 1: Chromatogram obtained from the GC-MS study with the extract of *Solanum surattense*

Table 1. Total ionic chromatogram (GC–MS) for the ethanol extract of *Solanum surattense* obtained with 70 eV Elite-1 fused silica capillary column with He. gas as the carrier.

No.	RT	Name of the compound	Molecular Formula	MW	Peak Area %
1	3.54	Hexanoic acid, ethyl ester	$C_8H_{16}O_2$	144	1.60
2	10.90	Dodecanoic acid	$C_{12}H_{24}O_2$	200	2.21
3	11.83	(1R,3R,4R,5R)-(-)-Quinic acid	$C_7H_{12}O_6$	192	3.29
4	13.33	Tetradecanoic acid	$C_{14}H_{28}O_2$	228	1.35
5	14.39	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296	8.54
6	16.15	n-Hexadecanoic acid	$C_{16}H_{32}O_2$	256	13.30
7	16.42	Hexadecanoic acid, ethyl ester	$C_{18}H_{36}O_2$	284	1.01
8	18.38	Phytol	$C_{20}H_{40}O$	296	8.17
9	18.71	9,12-Octadecadienoic acid (Z,Z)-	$C_{18}H_{32}O_2$	280	3.54
10	18.81	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	$C_{18}H_{30}O_2$	278	10.20
11	19.11	Octadecanoic acid	$C_{18}H_{36}O_2$	284	2.89
12	19.41	Octadecanoic acid, ethyl ester	$C_{20}H_{40}O_2$	312	0.44
13	20.79	2-Propenamide, N-[2-(dimethylamino)ethyl]-	$C_7H_{14}N_2O$	142	1.07
14	24.15	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester [Synonyms: Palmitin, 2-mono-]	$C_{19}H_{38}O_4$	330	1.25
15	24.62	1,2-Benzenedicarboxylic acid, diisooctyl ester	$C_{24}H_{38}O_4$	390	1.73
16	28.85	2,6,10,14,18,22-Tetracosahexaene, 2,6,10,15,19,23-hexamethyl-, (all-E)- [Synonyms: trans-Squalene]	$C_{30}H_{50}$	410	31.55
17	35.86	Vitamin E	$C_{29}H_{50}O_2$	430	7.86

Table 2: Major Phyto-components and its biological activities obtained through the GC-MS Study of *Solanum surattense* has been listed along with its active biological activities

Sl. No.	Retention Time	Peak Area %	Name of the Compound	Active biological activity
1.	3.54	1.60	Hexanoic acid, ethyl ester	Acidulant, Flavor
2.	10.90	2.21	Dodecanoic acid	Flavor
3.	11.83	3.29	(1R,3R,4R,5R)-(-)-Quinic acid	Choleretic
4.	13.33	1.35	Tetradecanoic acid	Flavor, Nematicide and Pesticide
5.	14.39	8.54	3,7,11,15-Tetramethyl-2-	Flavor

			hexadecen-1-ol	
6.	16.15	13.30	n-Hexadecanoic acid	Antioxidant, hypocholesterolemic nematicide, pesticide, anti-androgenic flavor, hemolytic, 5-Alpha reductase inhibitor
7.	16.42	1.01	Hexadecanoic acid, ethyl ester	Antioxidant, hypocholesterolemic nematicide, pesticide, anti-androgenic flavor, hemolytic, 5-Alpha reductase inhibitor
8.	18.38	8.17	Phytol	Cancer-Preventive
9.	18.81	10.20	9,12,15-Octadecatrienoic acid, (Z,Z,Z)-	Antiinflammatory, hypocholesterolemic cancer preventive, hepatoprotective, nematicide, insectifuge, antihistaminic antieczemic, antiacne, 5-Alpha reductase inhibitor, antiandrogenic, antiarthritic, anticoronary, insectifuge
10.	19.11	2.89	Octadecanoic acid	5-Alpha-Reductase-Inhibitor, Cosmetic, Flavor, Hypocholesterolemic, Lubricant, Perfumery, Propecic and Suppository
11.	24.15	1.25	Hexadecanoic acid, 2-hydroxy-1-(hydroxymethyl)ethyl ester [Synonyms: Palmitin, 2-mono-]	Abortifacient, Adrenocorticotrophic, Analgesic, Antialzheimeran, Antiarrhythmic, Antibacterial, Anticholinesterase, Antiinfarctal, Antiinflammatory, Antimalarial, Antipyretic, CNS-Depressant, Hypotensive, Inotropic, Pesticide, Respiradepressant and Uterotonic
12.	24.62	1.73	1,2-Benzenedicarboxylic acid, diisooctyl ester	Insecticide, Larvicide and Pesticide
13.	28.85	31.55	2,6,10,14,18,22-Tetracosahexaene, 2,6,10,15,19,23-hexamethyl-, (all-E)- [Synonyms: trans-Squalene]	Antibacterial, Antioxidant, Antitumor, Cancer-Preventive, Chemopreventive, Immunostimulant, Lipoxygenase-Inhibitor, Perfumery, Pesticide and Sunscreen
14.	35.86	7.86	Vitamin E	5-HETE-Inhibitor, Allergenic, Analgesic, AntiMD, AntiMS, AntiPMS, Antiaggregant, Antiaging, Antialzheimeran, Antianginal, Antiarteriosclerotic, Antiatherosclerotic, Antibronchitic, Anticariogenic, Anticataract, Antichorea, Anticoronary, Antidecubitic, Antidermatitic, Antidiabetic, Antidysmenorrheic, Antiepitheleomic, Antifibrositic, Antiherpetic, Antiinflammatory, Antiischaemic, Antileukemic, Antileukotriene, Antilithic, Antilupus, Antimastalgic, Antimyoclonic, Antineuritic, Antinitrosaminic, Antiophthalmic, Antiosteoarthritic, Antioxidant, Antiparkinsonian, Antiproliferant, Antiradicular, Antiretinopathic, Antisenility, Antisickling, Antispasmodic, Antisterility, Antistroke, Antisunburn, Antisyndrome-X, Antithalassemic, Antithrombotic, Antithromboxane-B2, Antitoxemic, Antitumor, Antitumor (Breast), Antitumor (Colorectal), Antitumor (Prostate), Antiulcerogenic, Apoptotic,

				Cancer-Preventive, Cerebroprotective, Circulatory-Stimulant, Hepatoprotective, Hypocholesterolemic, Hypoglycemic, Immunostimulant, Insulin-Sparing, Lipoxygenase-Inhibitor, Ornithine-Decarboxylase-Inhibitor, P21-Inducer, Phospholipase-A2-Inhibitor, Protein-Kinase-C-Inhibitor, Protein-Kinase-C-Inhibitor and Vasodilator

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