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Research Article

COMPARATIVE INSIGHTS INTO ULTRAVIOLET-B RADIATION-INDUCED BIOCHEMICAL MODULATIONS IN SENNA AURICULATA: A GAS CHROMATOGRAPHY-MASS SPECTROMETRY PROFILING STUDY

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ABSTRACT

Objectives: This study explores the transformative effects of ultraviolet B (UV-B) radiation on the phytochemical profile of *Senna auriculata* leaves, a plant known for its medicinally properties.

Methods: Utilizing gas chromatography-mass spectrometry, we systematically compared the phytochemical profiles of methanolic extracts from untreated leaves (SKC) and those exposed to UV-B radiation (SKT).

Results: The analysis revealed a total of 59 compounds in the untreated leaves (SKC) and 50 in the UV-B exposed leaves (SKT). Among these, 36 metabolites were common to both samples, while 23 were unique to SKC, and 14 were exclusive to SKT. Notable compounds induced by UV-B radiation included Cystamine, 2-Methyl-6-(5-methyl-2-thiazolin-2-ylamino) pyridine, and 1,2-Benzisothiazol-3-amine tbdms. These compounds exhibited significant bioactivities, demonstrating antioxidant, anticancer, and antibacterial properties.

Conclusion: The findings highlight the role of UV-B radiation as a modulator of secondary metabolism, reshaping the phytochemical profile of *S. auriculata* to enhance its adaptive resilience and therapeutic potential. This study sheds light on the complex interaction between environmental stressors and phytochemistry, providing valuable insights into how controlled UV-B exposure can optimize the medicinal properties of plants.

Keywords: Ultraviolet-B, Gas chromatography-mass spectrometry, Secondary metabolites, Antioxidant activity, Anticancer properties, Antibacterial properties.

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INTRODUCTION

Senna auriculata, commonly known as tanner's cassia or avaram. Senna, is a flowering plant belonging to the *Fabaceae* family. It is native to tropical regions, particularly South Asia, and is well-regarded in traditional ayurvedic medicine for its therapeutic properties. The plant is rich in various bioactive compounds, alkaloids, flavonoids, tannins, saponins, and phenolic acids, which contribute to its wide range of health benefits. The therapeutic applications of *S. auriculata* include its use in managing diabetes, inflammation, fever, and skin conditions. Research has highlighted its potential antidiabetic activity and antioxidant properties, making it a valuable resource in herbal medicine. In addition, the plant exhibits antimicrobial effects and may play a role in treating liver issues and other ailments due to its diverse phytochemical composition [1]. Overall, *S. auriculata* is not only significant in traditional healing practices but also offers a promising avenue for scientific research aimed at uncovering its full medicinal potential.

The plant is rich in flavonoids, including kaempferol, quercetin, and myricetin, which offer antioxidant, anti-inflammatory, and anti-diabetic effects. These flavonoids scavenge free radicals, reduce oxidative stress, and protect cells, potentially contributing to anti-aging effects [2,3]. Tannins are recognized for their antimicrobial properties and play a role in regulating blood sugar levels by inhibiting carbohydrate-digesting enzymes [4]. In addition, anthraquinones such as chrysophanol and emodin contribute to both laxative and antimicrobial effects [5]. Glycosides, particularly sennosides, enhance insulin sensitivity and support blood sugar management [6]. Furthermore, steroids and terpenoids offer anti-inflammatory and hepatoprotective benefits, while saponins may help lower cholesterol levels and boost the immune system [7,8]. The therapeutic benefits of *S. auriculata* include lowering blood glucose levels, aiding in diabetes management, promoting wound healing, and supporting liver function. It is commonly used in medicinal teas, dietary supplements, and skincare products.

Exposure to ultraviolet-B (UV-B) radiation can enhance the production of beneficial secondary metabolites in *S. auriculata.* UV-B exposure stimulates flavonoid biosynthesis, increasing antioxidant properties [9,10]. This exposure also raises levels of tannins and anthraquinones, thereby enhancing antimicrobial and anti-inflammatory effects [11]. Furthermore, UV-B may induce morphological changes, such as thicker leaves, that protect against UV damage [12].

UV-B exposure often triggers the biosynthesis of flavonoids, which play a crucial role in plant defense by absorbing UV rays and helping to protect plant tissues from potential damage. In *S. auriculata*, the increased production of flavonoids such as kaempferol, quercetin, and myricetin under UV-B stress enhances the plant's antioxidant activity. This boost in flavonoid levels may improve the plant's capacity to scavenge free radicals, thereby augmenting its anti-inflammatory and anti-diabetic properties [9,10]. Moreover, UV-B radiation induces oxidative stress,

prompting the plant to produce additional antioxidants as a defensive mechanism. For *S. auriculata*, this result in elevated antioxidant levels that protect cells from oxidative damage, supporting overall plant health and potentially amplifying its anti-aging benefits [13].

Moreover, UV-B exposure may stimulate the synthesis of tannins and anthraquinones. Tannins, known for their antimicrobial properties, enhance the plant's ability to fend off pathogens, while anthraquinones contribute to laxative effects and promote digestive health. This increase in secondary metabolites can improve *S. auriculata* effectiveness in traditional medicinal applications related to digestive health and infection prevention [5,11].

Prolonged UV-B exposure can also affect the morphology of *S. auriculata*, leading to adaptations that enhance its resilience. The plant may develop thicker leaves or a waxier surface as protective measures against UV damage. These structural changes can help minimize water loss and shield internal tissues from harmful radiation, promoting the overall health and survival of the plant in varied environmental conditions [12].

While moderate UV-B exposure can enhance the levels of beneficial compounds in *S. auriculata*, excessive or prolonged exposure may lead to cellular damage. High levels of UV-B radiation can stress the plant beyond its adaptive capacity, potentially resulting in negative effects on growth and overall vitality. Therefore, it is crucial to balance UV-B exposure to maximize the therapeutic properties of *S. auriculata* while ensuring its health and resilience in natural environments.

In this study, we analyzed the phytocomponents present in the methanolic extracts of both control leaves (SKC) and UV-B treated leaves (SKT) of *S. auriculata* using gas chromatography-mass spectrometry (GC-MS). This analysis aims to elucidate the impact of UV-B treatment on the phytochemical profile of the plant, providing insights into how varying levels of UV-B radiation influence its medicinal properties.

METHODS

Plant samples

Certified seeds of *S. auriculata* (L.) Roxb obtained commercial manufacture from Chennai. It was shown in experimental plots in the Pachaiyappa's College Botanical Garden, Chennai. One set of plant was grown under ambient solar radiation and another set of plants grown under 10% UV-B enhanced solar radiation.

Certified seeds of *S. auriculata* (L.) Roxb. were commercially obtained from Chennai. The seeds were sown in experimental field soil located in the Pachaiyappa's College Botanical Garden, Chennai, during October 2022. One set of plants was cultivated under natural environmental conditions (SKC), while another set was grown under enhanced solar radiation with 10% UV-B exposure (SKT).

Plant growth and UV-B treatment

The seeds were soaked for 6–7 hrs in running water. Separate soil beds were prepared for control (ambient) and UV-B treatment and seeds were sown in the experimental plots. Four experimental plots were prepared. Two plots were used for ambient conditions, and the remaining two were used for UV-B treatment. In each plot, 20 seeds were sown. The plants were watered regularly, and care was taken to avoid microbial or pest infection during the experimental period. Plants at the first foliage leaf stage were used for UV-B treatment. UV-B treatment was given to these plants for 2 h daily from 10 a.m. to 12 noon. Treatment was continued under ambient solar radiation and 10% UV-B enhanced solar radiation supplemented by a Philips TL 40W/12 sunlamp (Gloelampenfabrieken, Holland). The first formed leaves were collected for high-performance thin layer chromatography analysis. Before sowing, the seeds were soaked in tap water for 6–7 h. Separate soil beds were prepared for the control (ambient) and UV-B treatment groups, and the seeds were sown in the experimental plots. A total of four experimental plots were established, with two designated for the control group and the other two for UV-B treatment. In each plot, 20 seeds were sown. The plants were watered regularly, and measures were taken to prevent microbial or pest infections throughout the experimental period. Plants at the first foliage leaf stage were selected for UV-B treatment, which was administered for 2 h daily from 10 a.m. to 12 noon. This treatment continued under ambient solar radiation, supplemented by 10% UV-B enhanced solar radiation provided by a Philips TL 40W/12 sunlamp (Gloelampenfabrieken, Holland). The first formed leaves were subsequently collected for GC-MS analysis [14].

Collection of plant samples

Mature and healthy leaves of both SKC and SKT were harvested in the early morning and collected in polythene bags. They were then stored at room temperature for subsequent processing. The leaves were washed thoroughly with tap water and shade-dried for 5–6 days. Approximately 50 g of the air-dried leaves were ground into a fine powder using a mortar and pestle.

Crude extraction of plant

The extraction process was performed according to the method described by [15], with slight modifications. In brief, five grams of powdered plant material from each species was placed separately into two 100 mL conical flasks. Each flask was filled with 45 mL of methanol and shaken at 250 rpm for 72 h at a temperature of 37°C. The resulting mixture was filtered first through cotton gauze and then through Whatman No.1 filter paper. The filtrates were concentrated under vacuum using a rotary evaporator at room temperature to yield concentrated extracts of SKC and SKT. Subsequently, each extract underwent GC-MS analysis to identify the compounds present.

GC-MS analysis and identification of components

The GC-MS analysis of the methanolic extract of the leaves of both SKC and SKT was performed using a GC-MS of Hewlett-Packard 6890/5973 operating at 1000 eV ionization energy, equipped with Agilent 7890A/5975 C GC HP-5. Capillary column (phenyl methyl siloxane, 25 m × 0.25 mm i.d.) with Helium (He) was used as the carrier gas with split ratio 1:5. Oven temperature was 80°C (2 min) to 280°C at 1–40°C/min, detector temperature 250–280°C, and carrier gas He (0.9 mL/min). 2.0 µL of respective diluted samples was manually injected in the splitless mode, with split ratio and with mass scan of 50–600 amu. Total running time of GC-MS is 50 min, the relative percentage of each extract constituent was expressed as a percentage with peak area normalization.

Interpretation on mass spectrum of GC-MS was done using the database of the National Institute of Standards and Technology (NIST) and Wiley library for mass spectra, having more than 62000 patterns. The mass spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The name, molecular weight (MW), and structure of the components of the test materials were ascertained.

RESULTS

Chromatogram of the SKC

In the current study, a total of 59 distinct phytocomponents were identified in the methanolic extract of SKC leaves. The identified compounds, along with their retention indices (RT), molecular formulae, molecular structures, MW, and percentage compositions (area %), are detailed in Table 1. The predominant compounds found in SKC include dl-Alanyl-dl-.alpha.-amino-n-butyric acid (38.631% area), 2-Dimethylaminomethyl-4-chloro-1-naphthol (19.379% area), Topotecan (16.246% area), 2-Butenethioic acid, S-[2-(acetylamino) ethyl] ester (7.14% area), and propane (7.32% area). The GC-MS chromatogram revealed 47 distinct peaks, confirming the presence of 59 compounds with their respective RTs (Fig. 1).

The mass spectra of each phytochemical were compared with those in the NIST and Wiley libraries, leading to the characterization

Table 1: Phytocomponents identified in *Senna auriculata* extract

S. No.	CAS	Name of the compound	Molecular formula	Molecular weight	Peak area (%)
1	000110-74-7	Formic acid, propyl ester	$C_5H_{11}O_3N$	133.14	4.082
2	167163-22-6	2-Dimethylaminomethyl-4-chloro-1-naphthol	$C_6H_8O_3$	128.13	19.379
3	000075-21-8	Ethylene oxide	$C_{17}H_{30}OSi$	278.5	3.129
4	1000327-59-6	Acetic acid, 2-(1-methyl-2-oxohydrazino)-, N'-[(E)-(2-hydroxyphenyl) methylidene] hydrazide, N-oxide	$C_{12}H_{22}Si_2$	222.47	3.171
5	001225-56-5	Desmethyldoxepin	$C_{13}H_{22}OSi_2$	250.48	4.369
6	003914-53-2	dl-Alanyl-dl-.alpha.-amino-n-butyric acid	$C_{24}H_{36}O2Si_2$	412.7	38.631
7	1000131-70-7	Topotecan	$C_{24}H_{38}O2Si_2$	414.72	16.246
8	063493-28-7	2-Pentanamine	$C_{14}H_{26}Si_2$	250.47	6.405
9	000111-40-0	1,2-Ethanediamine, N-(2-aminoethyl)-	$C_7H_{22}O_2Si_3$	221.5	4.588
10	284489-45-8	Benzaldehyde, 3,5-dichloro-2-phenylsulfonyloxy-, (2,2-dimethyl) hydrazine	$C_{15}H_{14}Cl_2N_2O_3S$	373.3	1.87
11	103439-06-1	Benzeneethanamine, 4-fluoro-.beta.,3-dihydroxy-N-methyl-	$C_9H_{12}FNO_2$	185.2	1.87
12	000124-38-9	Carbon dioxide	CO_2	44.009	0.80
13	1000333-70-1	Ala-gly, trimethylsilyl ester	$C_8H_{18}N_2O_3Si$	218.33	0.80
14	1000194-89-1	N-Heptyl-N'-(6-{6-[2-(heptyl-methyl-carbamoyl) -acetylamino]-hexylamino}-hexyl)-N-methyl-malonamide	$C_{34}H_{67}N_5O_4$	609.9	2.19
15	000074-98-6	Propane	$CH_3CH_2CH_3$	44.10	7.32
16	023784-20-5	2-Butenethioic acid, S-[2-(acetylamino) ethyl] ester	$C_8H_{13}NO_2S$	187.26	7.14
17	001635-26-3	2,4 (1H,3H)-Pyrimidinedione, dihydro-5-hydroxy-	$C_4H_6N_2O_3$	130.1	7.14
18	304882-71-1	3-Chloro-N-[2-methyl-4 (3H)-oxo-3-quinazolinyl]-2-thianaphthenecarboxamide	$C_{18}H_{12}ClN_3O_2S$	369.8	5.58
19	331864-72-3	Ethane dicarboxamide, N-allyl-N'-(2,5-dimethylphenyl)-	$C_{13}H_{16}N_2O_2$	232.28	5.58
20	002919-23-5	Cyclobutanol	C_4H_8O	72.11	5.16
21	002749-11-3	1-Propanol, 2-amino-, (S)-	C_3H_9NO	75.11	1.15
22	000338-69-2	D-Alanine	$C_3H_7NO_2$	89.09	1.15
23	035320-23-1	(R)-(-)-2-Amino-1-propanol	C_3H_9NO	75.11	1.15
24	1000147-64-6	2-p-Nitrophenyl-oxadiazol-1,3,4-one-5	$C_8H_5N_3O_4$	207.14	0.47
25	1000367-02-3	tert-Butyl (5-isopropyl-2-methylphenoxy) dimethylsilane	$C_{16}H_{28}OSi$	264.48	0.47
26	029876-70-8	1,2-Benzisothiazole-3-acetic acid, methyl ester	$C_{10}H_9NO_2S$	207.25	0.47
27	1000161-21-8	2,4,6-Cycloheptatrien-1-one, 3,5-bis-trimethylsilyl-	$C_{13}H_{22}OSi_2$	250.48	0.94
28	101869-40-3	1-Nitro-9,10-dioxo-9,10-dihydro-anthracene-2-carboxylic acid diethylamide	$C_{19}H_{16}N_2O_5$	352.3	0.59
29	017928-28-8	Methyltris (trimethylsiloxy) silane	$C_{10}H_{30}O_3Si_4$	310.68	0.59
30	094427-47-1	Hexahydropyridine, 1-methyl-4-[4,5-dihydroxyphenyl]-	$C_{12}H_{17}NO_2$	207.27	0.80
31	000605-67-4	Benzo[h] quinoline, 2,4-dimethyl-	$C_{15}H_{13}N$	207.27	0.80
32	104926-37-6	Cyclohexane-1,3-dione, 2-allylaminomethylene-5,5-dimethyl-	$C_{12}H_{17}NO_2$	207.27	0.80
33	097389-70-3	4-Methyl-2-trimethylsilyloxy-acetophenone	$C_{12}H_{18}O_2Si$	222.35	0.99
34	003558-24-5	1H-Indole, 1-methyl-2-phenyl-	$C_{15}H_{13}N$	207.27	0.99
35	000088-58-4	1,4-Benzenediol, 2,5-bis (1,1-dimethylethyl)-	$C_{14}H_{22}O_2$	222.32	0.99
36	1000306-25-6	Diethyl-1-(carb-n-butoxy) propylphosphonate	$C_{12}H_{25}O_5P$	280.3	2.51
37	000541-05-9	Cyclotrisiloxane, hexamethyl-	$C_6H_{18}O_3Si_3$	222.46	2.51
38	055429-29-3	Arsenous acid, tris (trimethylsilyl) ester	$C_9H_{27}AsO_3Si_3$	342.49	2.51
39	055751-83-2	2-Ethylacridine	$C_{15}H_{13}N$	207.27	0.71
40	1000258-63-4	Benz[b]-1,4-oxazepine-4 (5H)-thione, 2,3-dihydro-2,8-dimethyl-	$C_{11}H_{13}NOS$	207.29	0.71
41	330455-64-6	Benzene, 2-[(tert-butyldimethylsilyl) oxy]-1-isopropyl-4-methyl-	$C_{16}H_{28}OSi$	264.48	4.10
42	013183-70-5	1,4-Bis (trimethylsilyl) benzene	$C_{12}H_{22}Si_2$	222.47	4.10
43	1000283-54-9	Trimethyl[4-(2-methyl-4-oxo-2-pentyl) phenoxy] silane	$C_{15}H_{24}O_2Si$	264.43	0.88
44	025237-79-0	Trimethyl (4-tert-butylphenoxy) silane	$C_{13}H_{22}OSi$	222.4	0.88
45	001873-88-7	1,1,1,3,5,5,5-Heptamethyltrisiloxane	$C_7H_{21}O_2Si_3$	221.5	1.83
46	031897-93-5	N-Methyl-1-adamantaneacetamide	$C_{13}H_{21}NO$	207.31	1.83
47	1000366-57-5	Tris (tert-butyldimethylsilyloxy) arsane	$C_{18}H_{45}AsO_3Si_3$	468.7	1.11
48	003555-45-1	Silicic acid, diethyl bis (trimethylsilyl) ester	$C_{10}H_{28}O_4Si_3$	296.58	1.11
49	019095-23-9	Heptasiloxane, 1,1,3,3,5,5,7,7,9,9,11,11,13,13-tetradecamethyl-	$C_{14}H_{42}O_6Si_7$	503.07	1.11
50	1000375-89-1	7,7,9,9,11,11-Hexamethyl-3,6,8,10,12,15-hexaoxa-7,9,11-trisilaheptadecane	$C_{14}H_{36}O_6Si_3$	384.69	1.67
51	030020-98-5	1-Methyl-3-phenylindole	$C_{15}H_{13}N$	207.27	1.67
52	025578-89-6	Benz[e] azulene-3,8-dione, 3a, 4,6a, 7,9,10,10a, 10b-octahydro-3a, 10a-dihydroxy-5-(hydroxymethyl)-2,10-dimethyl	$C_{17}H_{22}O_5$	306.4	2.11
53	036944-99-7	5-Methyl-2-phenylindolizine	$C_{15}H_{13}N$	207.27	2.18
54	1000137-02-9	Benzestrol di-TMS derivative	$C_{26}H_{42}O_2Si_2$	442.8	1.81
55	1000129-52-1	Indole-2-one, 2,3-dihydro-N-hydroxy-4-methoxy-3,3-dimethyl-	$C_{11}H_{13}NO_3$	207.23	2.80
56	055012-80-1	Silane, trimethyl[5-methyl-2-(1-methylethyl) phenoxy]-	$C_{13}H_{22}OSi$	222.4	0.70
57	000141-62-8	Tetrasiloxane, decamethyl-	$C_{10}H_{30}O_3Si_4$	310.68	0.84
58	001140-08-5	2-Methyl-7-phenylindole	$C_{15}H_{13}N$	207.27	0.89
59	000052-31-3	Cyclobarbital	$C_{12}H_{16}N_2O_3$	236.27	1.12

and identification of these 59 phytocomponents. Notably, several identified components exhibit biological activities, which are summarized in Table 2. These activities are referenced from Dr. Jim Duke's phytochemical and ethnobotanical databases, maintained by

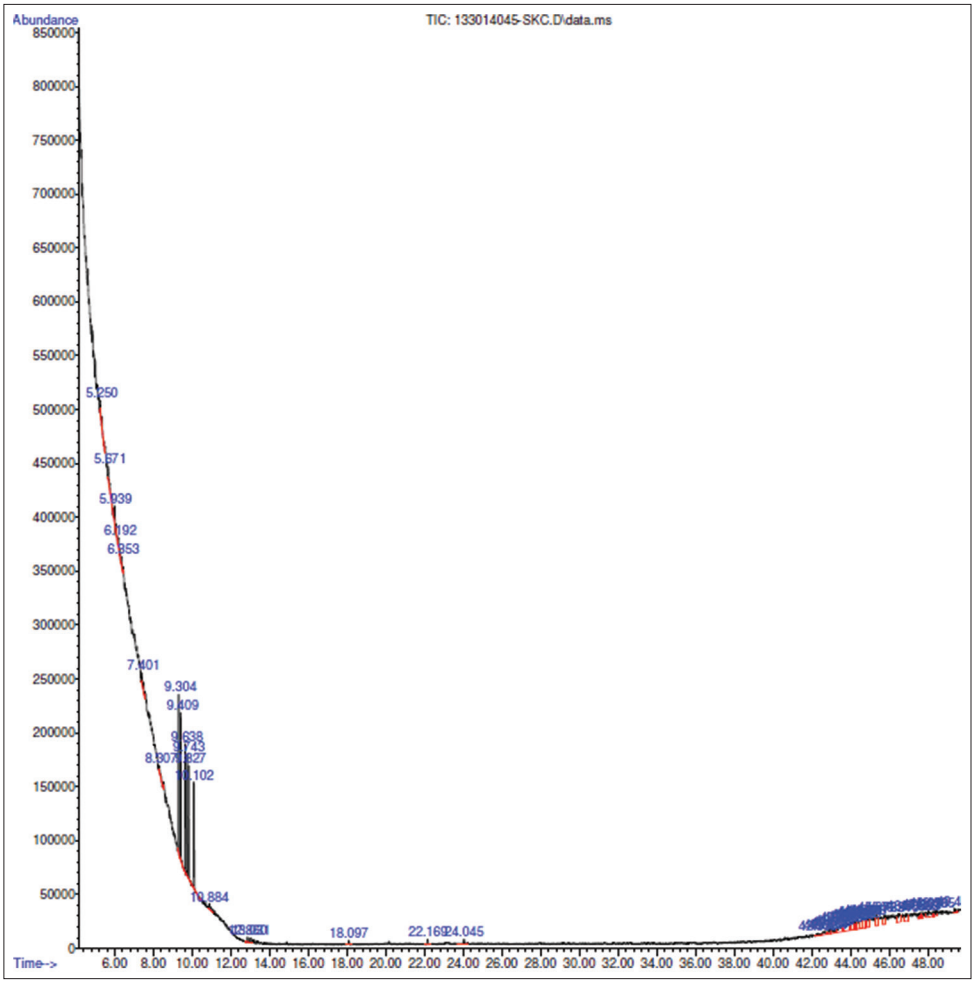

Fig. 1: Gas chromatography-mass spectrometry chromatogram of *Senna auriculata* extract (SKC)

the agricultural research service of the United States Department of Agriculture (USDA) [16].

Chromatogram of the SKT

In this study, a total of 50 distinct phytocomponents were identified in the methanolic extract of SKT leaves. The identified compounds, along with their RTs, molecular formulae, molecular structures, MWs, and percentage compositions (area %), are presented in Table 3. The predominant compounds in SKT included ethane dicarboxamide, N-allyl-N'-(2, 5-dimethylphenyl)- (14.41% area), 2-Butenethioic acid, S-[2-(acetylamino)ethyl] ester (14.41% area), propane (14.41% area), and desmethyldoxepin (11.53% area). The GC-MS chromatogram displayed 47 distinct peaks, confirming the presence of 50 compounds with their respective RTs (Fig. 2).

On comparing the mass spectra of each phytochemical with the NIST and Wiley libraries, a total of 50 phytocomponents were characterized and identified. Several of these identified components exhibit biological activities, which are summarized in Table 3. These activities are referenced from Dr. Jim Duke's phytochemical and ethnobotanical databases maintained by the agricultural research service of the USDA [16].

Furthermore, exposure to UV-B radiation resulted in alterations to the phytochemical content in *S. auriculata* leaves. The UV-B-treated *S. auriculata* extract revealed the presence of 50 compounds, compared to 59 compounds identified in the control SKC extract. Notably, 36 phytochemicals were found to be common between both SKC and SKT, while 23 compounds were exclusive to SKC, and 14 compounds were unique to the UV-B treated samples.

DISCUSSION

In the present study, the effects of UV-B radiation on *S. auriculata*, a traditional medicinal plant, were assessed by analyzing the phytocomponents in the methanolic extracts of both control (SKC) and UV-B treated leaves (SKT) using GC-MS. A comparison of the GC-MS chromatograms revealed that UV treatment significantly altered the phytocomponent profile of *S. auriculata*, indicating that UV-B radiation influences the composition of phytochemicals, which may, in turn, affect the plant's growth and defense mechanisms.

Fourteen, compounds were identified exclusively in the UV-treated extract (SKT) compared to the control extract (SKC). Notable among these were Cystamine, 2-Methyl-6-(5-methyl-2-thiazolin-2-ylamino) pyridine, and 1,2-Benzisothiazol-3-amine tbdms, all of which are known for their significant bioactivities.

Cystamine, in particular, has been reported to exhibit antioxidant, neuroprotective, and immunomodulatory properties. According to Paul and Snyder [26], cystamine's antioxidant capabilities are crucial for combating oxidative stress, thereby preventing cellular damage and promoting cellular health. Recent studies, such as those conducted by Maza *et al*., [27], have further highlighted cystamine's potential therapeutic effects in neurodegenerative diseases, underscoring its importance in both antioxidant defense and neuroprotection.

2-Methyl-6-(5-methyl-2-thiazolin-2-ylamino) pyridine has been shown to exhibit significant anticancer activity. Research by Adetutu *et al*. [19]

Table 2: Phytocomponents identified in un Treated *Senna auriculata* extract

Sl. No	CAS	Name of the compound	Molecular formula	Molecular weight	Peak area (%)
1	1000327-59-6	Acetic acid, 2-(1-methyl-2-oxohydrazino)-, N'-[(E)-(2-hydroxyphenyl) methylidene] hydrazide, N-oxide	$C_{12}H_{22}Si_2$	222.47	0.8
2	103439-06-1	Benzeneethanamine, 4-fluoro-. beta.,3-dihydroxy-N-methyl-	$C_9H_{12}FNO_2$	185.2	1.56
3	003914-53-2	dl-Alanyl-dl-.alpha.-amino-n-butyric acid	$C_{24}H_{36}O2Si_2$	412.7	0.8
4	068516-51-8	1,4-Benzenedicarboxamide, N, N'-bis (2-hydroxy-1-methyl-2-phenylethyl)-	$C_{26}H_{28}N_2O_4$	432.52	0.75
5	030802-27-8	l-Alanyl-l-alanyl-l-alanine methyl ester	$C_{10}H_{19}N_3O_4$	245.28	0.75
6	063493-28-7	2-Pentanamine	$C_{14}H_{26}Si_2$	250.47	1.11
7	152434-85-0	Benzeneethanamine, 3,4-benzyloxy-2,5-difluoro-. beta.-hydroxy-N-methyl-	$C_{23}H_{23}F_2NO_3$	399.4	1.11
8	001225-56-5	Desmethyldoxepin	$C_{13}H_{22}OSi_2$	250.48	11.53
9	000124-38-9	Carbon dioxide	CO_2	44.009	2.63
10	000075-21-8	Ethylene oxide	$C_{17}H_{30}OSi$	278.5	11.53
11	023784-20-5	2-Butenethioic acid, S-[2-(acetylamino) ethyl] ester	$C_8H_{13}NO_2S$	187.26	14.41
12	284489-45-8	Benzaldehyde, 3,5-dichloro-2-phenylsulfonyloxy-, (2,2-dimethyl) hydrazine	$C_{15}H_{14}Cl_2N_2O_3S$	373.3	2.55
13	103439-07-2	Benzeneethanamine, 2-fluoro-. beta.,5-dihydroxy-N-methyl-	$C_9H_{12}FNO_2$	185.2	2.55
14	002919-23-5	Cyclobutanol	C_4H_8O	72.11	1.96
15	000302-72-7	dl-Alanine	$C_3H_7NO_2$	89.094	1.96
16	167163-22-6	2-Dimethylaminomethyl-4-chloro-1-naphthol	$C_6H_8O_3$	128.13	1.96
17	000074-98-6	Propane	$CH_3CH_2CH_3$	44.10	14.41
18	000051-85-4	Cystamine	$C_4H_{12}N_2S_2$	152.274	4.98
19	331864-72-3	Ethane dicarboxamide, N-allyl-N'-(2,5-dimethylphenyl)-	$C_{13}H_{16}N_2O_2$	232.28	14.41
20	006318-55-4	cis-Aconitic anhydride	$C_6H_4O_5$	156.09	4.17
21	001635-26-3	2,4 (1H,3H)-Pyrimidinedione, dihydro-5-hydroxy-	$C_4H_6N_2O_3$	130.1	4.02
22	304882-71-1	3-Chloro-N-[2-methyl-4 (3H)-oxo-3-quinazolinyl]-2-thianaphthenecarboxamide	$C_{18}H_{12}ClN_3O_2S$	369.8	4.08
23	094427-47-1	Hexahydropyridine, 1-methyl-4-[4,5-dihydroxyphenyl]-	$C_{12}H_{17}NO_2$	207.27	0.41
24	003555-45-1	Silicic acid, diethyl bis (trimethylsilyl) ester	$C_{10}H_{28}O_4Si_3$	296.58	0.41
25	339352-50-0	2-Methyl-6-(5-methyl-2-thiazolin-2-ylamino) pyridine	$C_{10}H_{13}N_3S$	207.295	0.41
26	1000306-25-6	Diethyl-1-(carb-n-butoxy) propylphosphonate	$C_{12}H_{25}O_5P$	280.3	1.62
27	1000161-21-8	2,4,6-Cycloheptatrien-1-one, 3,5-bis-trimethylsilyl-	$C_{13}H_{22}OSi_2$	250.48	0.69
28	1000277-38-2	1H-1,2,4-Triazole-5 (4H)-thione, 4-allyl-3-(3-furyl)-	$C_9H_9N_3OS$	207.25	1.63
29	1000258-63-4	Benz[b]-1,4-oxazepine-4 (5H)-thione, 2,3-dihydro-2,8-dimethyl-	$C_{11}H_{13}NOS$	207.29	1.63
30	1000366-57-5	Tris (tert-butyldimethylsilyloxy) arsane	$C_{18}H_{45}AsO_3Si_3$	468.7	2.28
31	055012-80-1	Silane, trimethyl[5-methyl-2-(1-methylethyl) phenoxy]-	$C_{13}H_{22}OSi$	222.4	0.69
32	000605-67-4	Benzo[h] quinoline, 2,4-dimethyl-	$C_{15}H_{13}N$	207.27	0.4
33	000541-05-9	Cyclotrisiloxane, hexamethyl-	$C_6H_{18}O_3Si_3$	222.46	0.4
34	1000332-57-2	1,2-Benzisothiazol-3-amine tbdms	$C_{13}H_{20}N_2SSi$	264.46	0.4
35	055751-83-2	2-Ethylacridine	$C_{15}H_{13}N$	207.27	0.46
36	001873-88-7	1,1,1,3,5,5,5-Heptamethyltrisiloxane	$C_7H_{21}O_2Si_3$	221.5	2.28
37	054889-98-4	Methanol, [4-(1,1-dimethylethyl) phenoxy]-, acetate	$C_{13}H_{18}O_3$	222.284	2.46
38	005956-09-2	2H-3,9a-Methano-1-benzoxepin, octahydro-2,2,5a, 9-tetramethyl-, [3R-(3.alpha.,5a.alpha.,9.alpha.,9a. alpha.)]-	$C_{15}H_{26}O$	222.37	2.46
39	025237-79-0	Trimethyl (4-tert-butylphenoxy) silane	$C_{13}H_{22}OSi$	222.4	2.03
40	000052-31-3	Cyclobarbital	$C_{12}H_{16}N_2O_3$	236.27	1.62
41	000141-62-8	Tetrasiloxane, decamethyl-	$C_{10}H_{30}O_3Si_4$	310.68	1.72
42	055429-29-3	Arsenous acid, tris (trimethylsilyl) ester	$C_9H_{27}AsO_3Si_3$	342.49	1.72
43	003558-24-5	1H-Indole, 1-methyl-2-phenyl-	$C_{15}H_{13}N$	207.27	1.72
44	017993-84-9	N, N-Dimethyl-4-nitroso-3-(trimethylsilyl) aniline	$C_{11}H_{18}N_2OSi$	222.36	1.69
45	036944-99-7	5-Methyl-2-phenylindolizine	$C_{15}H_{13}N$	207.27	0.67
46	1000375-89-1	7,7,9,9,11,11-Hexamethyl -3,6,8,10,12,15-hexaoxa-7,9,11-trisilaheptadecane	$C_{14}H_{36}O_6Si_3$	384.69	0.67
47	031897-93-5	N-Methyl-1-adamantaneacetamide	$C_{13}H_{21}NO$	207.31	0.5
48	1000282-91-2	Phenylacetic acid, 2-(1-adamantyl) ethyl ester	$C_{20}H_{26}O2$	298.4	0.5
49	025578-89-6	Benz[e] azulene-3,8-dione, 3a, 4,6a, 7,9,10,10a, 10b-octahydro-3a, 10a-dihydroxy-5-(hydroxymethyl)-2,10-dimethyl	$C_{17}H_{22}O_5$	306.4	0.87
50	1000129-52-1	Indole-2-one, 2,3-dihydro-N-hydroxy-4-methoxy-3,3-dimethyl-	$C_{11}H_{13}NO_3$	207.23	0.46

indicates that this compound can inhibit cancer cell proliferation, positioning it as a promising candidate for further anticancer drug development. Supporting this, recent findings by Mozaffari *et al*. [28] highlight that thiazole derivatives possess anticancer properties by

Table 3: Biological activity of phytocomponents identified in UV-B treated *Senna auriculata* extract

Sl. No	Name of the compound	Biological activity	References
1	Acetic acid, 2-(1-methyl-2-oxohydrazino)-, N'-[(E)-(2-hydroxyphenyl) methylidene] hydrazide, N-oxide	No activity reported	
2	Benzeneethanamine, 4-fluoro-.beta.,3-dihydroxy-N-methyl-	No activity reported	
3	dl-Alanyl-dl-.alpha.-amino-n-butyric acid	No activity reported	
4	1,4-Benzenedicarboxamide, N, N'-bis (2-hydroxy-1-methyl-2-phenylethyl)-	No activity reported	
5	l-Alanyl-l-alanyl-l-alanine methyl ester	No activity reported	
6	2-Pentanamine	No activity reported	
7	Benzeneethanamine, 3,4-benzyloxy-2,5-difluoro-.beta.-hydroxy-N-methyl-	No activity reported	
8	Desmethyldoxepin	Anti-anxiety and anti-histamine properties	Badenhorst *et al*., 2000. [17]
9	Carbon dioxide	No activity reported	No activity reported
10	Ethylene oxide	No activity reported	
11	2-Butenethioic acid, S-[2-(acetylamino) ethyl] ester	No activity reported	
12	Benzaldehyde, 3,5-dichloro-2-phenylsulfonyloxy-, (2,2-dimethyl) hydrazone	No activity reported	
13	Benzeneethanamine, 2-fluoro-.beta.,5-dihydroxy-N-methyl-	No activity reported	
14	Cyclobutanol	No activity reported	
15	dl-Alanine	No activity reported	
16	2-Dimethylaminomethyl-4-chloro-1-naphthol	No activity reported	
17	Propane	No activity reported	
18	Cystamine	Antioxidant , neuroprotective, immunomodulation	Paul and Snyder, 2019 [18]
19	Ethane dicarboxamide, N-allyl-N'-(2,5-dimethylphenyl)-	No activity reported	
20	cis-Aconitic anhydride	No activity reported	
21	2,4 (1H,3H)-Pyrimidinedione, dihydro-5-hydroxy-	No activity reported	
22	3-Chloro-N-[2-methyl-4 (3H)-oxo-3-quinazolinyl]-2-thianaphthenecarboxamide	No activity reported	
23	Hexahydropyridine, 1-methyl-4-[4,5-dihydroxyphenyl]-	No activity reported	
24	Silicic acid, diethyl bis (trimethylsilyl) ester	No activity reported	
25	2-Methyl-6-(5-methyl-2-thiazolin-2-ylamino) pyridine	Anticancer	Adetutu *et al*., 2022 [19]
26	Diethyl-1-(carb-n-butoxy) propylphosphonate	No activity reported	
27	2,4,6-Cycloheptatrien-1-one, 3,5-bis-trimethylsilyl-	Antioxidant activity	Bhama Devi *et al*., 2018 [20]
28	1H-1,2,4-Triazole-5 (4H)-thione, 4-allyl-3-(3-furyl)-	No activity reported	
29	Benz[b]-1,4-oxazepine-4 (5H)-thione, 2,3-dihydro-2,8-dimethyl-	No activity reported	
30	Tris (tert-butyldimethylsilyloxy) arsane	No activity reported	
31	Silane, trimethyl[5-methyl-2-(1-methylethyl) phenoxy]-	No activity reported	
32	Benzo[h] quinoline, 2,4-dimethyl-	Anticancer, antibacterial and antioxidants	Li *et al*., 2014 [21]
33	Cyclotrisiloxane, hexamethyl-	No activity reported.	
34	1,2-Benzisothiazol-3-amine tbdms	Anticancer, antibacterial, antioxidants, anti-diabetes	Li *et al*., 2014 [21]; Murali and Meena Devi., 2023 [22]
35	2-Ethylacridine	Anti-inflammatory, antibacterial, and antitumor agents	Manju and Jegadeeshkumar 2023 [23]; Muthukrishnan *et al*., 2022 [24]
36	1,1,1,3,5,5,5-Heptamethyltrisiloxane	No activity reported	
37	Methanol, [4-(1,1-dimethylethyl) phenoxy]-, acetate	No activity reported	
38	2H-3,9a-Methano-1-benzoxepin, octahydro-2,2,5a, 9-tetramethyl-, [3R-(3.alpha.,5a.alpha.,9.alpha.,9a.alpha.)]-	No activity reported	
39	Trimethyl (4-tert-butylphenoxy) silane	No activity reported	
40	Cyclobarbital	No activity reported	
41	Tetrasiloxane, decamethyl-	No activity reported	
42	Arsenous acid, tris (trimethylsilyl) ester	No activity reported	
43	1H-Indole, 1-methyl-2-phenyl-	No activity reported	
44	N, N-Dimethyl-4-nitroso-3-(trimethylsilyl) aniline	No activity reported	
45	5-Methyl-2-phenylindolizine	No activity reported	
46	7,7,9,9,11,11-Hexamethyl-3,6,8,10,12,15-hexaoxa-7,9,11-trisilaheptadecane	No activity reported	
47	N-Methyl-1-adamantaneacetamide	Larvicidal and repellent activity	Chellappandian *et al*., 2022 [25]
48	Phenylacetic acid, 2-(1-adamantyl) ethyl ester	No activity reported	
49	Benz[e] azulene-3,8-dione, 3a, 4,6a, 7,9,10,10a, 10b-octahydro-3a, 10a-dihydroxy-5-(hydroxymethyl)-2,10-dimethyl	No activity reported	
50	Indole-2-one, 2,3-dihydro-N-hydroxy-4-methoxy-3,3-dimethyl-	No activity reported	

UV-B: Ultraviolet B

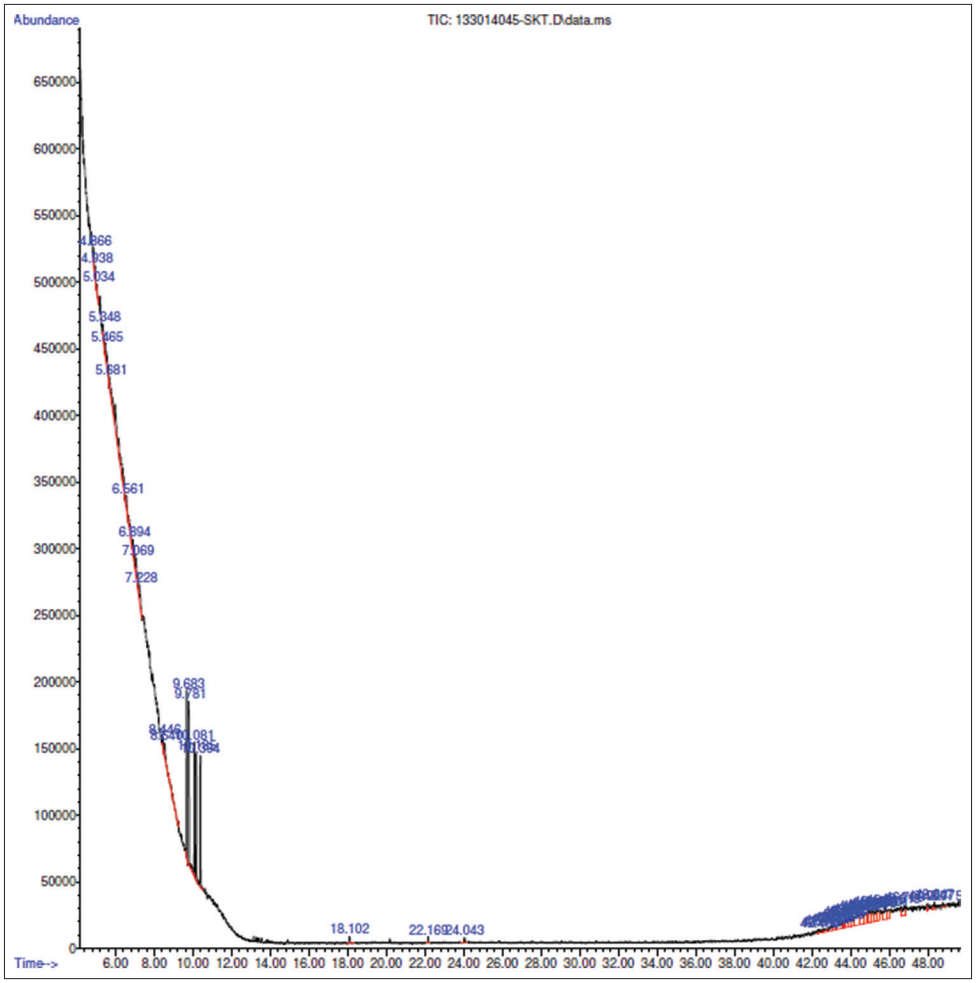

Fig. 2: Gas chromatography-mass spectrometry chromatogram of treated *Senna auriculata* extract (SKT)

inducing apoptosis in cancer cells. Another noteworthy compound, 1,2-Benzisothiazol-3-amine tbdms, is recognized for its diverse bioactivities, including anticancer, antibacterial, antioxidant, and anti-diabetic effects. Li *et al*., [21] demonstrated its efficacy against various cancer cell lines, while Murali and Meena Devi [22,29] emphasized its broad-spectrum antibacterial activity and potential in diabetes treatment due to its ability to enhance insulin sensitivity. A recent review by Sharma *et al*., and Sahoo *et al*., [30,31] further corroborates the extensive therapeutic applications of benzisothiazole derivatives, particularly their potential in developing multifunctional drug candidates targeting various health conditions, including cancer and metabolic disorders.

CONCLUSION

This study demonstrates that UV-B radiation significantly alters the phytochemical composition of *S. auriculata*, with 14 unique compounds identified in the UV-treated extract. Notably, reports suggest 2-Methyl-6-(5-methyl-2-thiazolin-2-ylamino) pyridine and 1,2-Benzisothiazol-3-amine tbdms exhibit promising bioactivities, including anticancer, antibacterial, antioxidant, and anti-diabetic properties. These findings suggest that UV-B treatment may enhance the therapeutic potential of *S. auriculata*, warranting further research into the mechanisms and applications of these compounds in drug development.

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AUTHOR'S CONTRIBUTION

Murugan Selvakumar: Designing experiments, protocols, fieldwork and data collection. Shanthi Natarajan: Initiated the research idea or framework and provided the guidance. Sangeetha Soundararajan: Involved in designing experiments, protocols. Sathish Kumar Boobalan: Wrote the initial draft of the manuscript, Visualization, Methodology. Murugesan Subbiah: Reviewed and revised the manuscript critically for important intellectual content.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this article.

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