

Accessing the Bioactive Compounds of Thaumatococcus Daniellii Leaf Extract in Rajasthan by Gc-Ms

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Abstract

Plant extract have an immense capacity to synthesize secondary metabolites or phytochemicals which have pharmacological properties. They are generally regarded as safe, efficient and good alternative to replace antibiotic growth promoters and reduce environmental waste. The GCMS analysis of Thaumatococcus daniellii extracts (Table 1) identified 29 compounds representing 93.38 %. The dominant constituents in Thaumatococcus daniellii extracts are: Hexadecanoic acid (20.82 %), 4-Methyl Octane (13.81 %), 1,8-Cineole (12.72 %), Squalene (9.66 %), 13-Tetradec-11-yn-1-ol (9.44 %), α -Terpinolene (9.02 %) and β -Gurjunene (8.40 %). However, 2-Pentylfuran (0.01 %), Isophytol (0.02 %), Methyl nonanoate (0.06 %), α -Cedrene (0.07 %), β -Linalol (0.09 %), α -Ionone (0.12 %), Cis-7-Hexadecenal (0.12 %) amongst others are the minor compounds. Analysis of the chemical constituents based on the class of compounds revealed the presence of non-terpenes (53.18 %) followed by diterpenes (14.55 %), triterpenes (12.62 %), sesquiterpenes (8.72 %), apocarotenes (3.40 %) and monoterpenes (0.91 %). However, all these compounds can perform multiple biological activities including, anti-inflammatory, antioxidant, anti-tumor, immuno-stimulatory, gastro-protective, anti-helminthic, anti-diabetic amongst others.

Keywords: thaumatococcus daniellii; phytochemicals; antibiotics; therapeutic; chemicals

Introduction

Thaumatococcus daniellii which belongs to the family Marantaceae is a rhizomatous flowering plant which is native to West Africa but have recently been introduced to Australia, Singapore and India [1]. The plant is highly medicinal due to the presence of numerous phyto-components such as, tannins, alkaloids, flavonoids, steroids, terpenoids, glycosides and saponins which possess anti-inflammatory, antiplatelet, cytotoxicity, angiogenic, anti-tumor, anti-neoplastic, antiviral, sedative, muscle relaxant, cytotoxic, antiviral, insecticidal, cardioprotective, analgesic, inhibition of lipid peroxidation, anti-inflammatory, fungicidal, antiprotozoal, antimalarial, and antirheumatic, antifertility, antinociceptive amongst others [2]. [15] reported that the proximate composition of Thaumatococcus daniellii leaf revealed the presence of ash (10.15 %), protein (20.14 %), lipids (11.42 %), fibre (13.78 %) and carbohydrate (34.57 %). [3] reported that Thaumatococcus daniellii leaf contains, vitamin A (3.1 mg/100g), vitamin B1 (1.07 mg/100g), vitamin B3 (1.32 mg/100g), vitamin B5 (1.11 mg/100g), vitamin B6 (16.34 mg/100g), B12 (11.86 mg/100g) and vitamin C (25.19 mg/100g). Aqueous extract from the leaf of Thaumatococcus daniellii have shown gastro-protective, hypotensive and hypo-lipidemic effect [3,10]. They have also been reported to inhibit the activities of Pseudomonas aeruginosa, Klebsiella

pneumonia, Escherichia coli, Salmonella spp, Microsporum canis, Staphylococcus aureus, Helicobacter pylori and Candida albicans [4,11]. Methanolic and ethanolic extract from the leaf of Thaumatococcus daniellii have shown invivo antioxidant, antimicrobial, immuno-stimulatory, analgesic and anti-inflammatory activities [5]. Root decoctions are used in the treatment of cough, catarrh, allergic eruptions, somniferous, nervousness, sedative, and hypotensive, Diabetes, smooth muscle relaxant in respiratory diseases, prostate diseases, amongst others [6,9]. Previous reports of [7] have shown that the major compounds identified in hexane extract of Thaumatococcus daniellii leaves contains, Tetraacetone (27.00 %), 2-Methyl octacosane (15.99 %), L-ascorbic acid (15.07 %) and chloro-acetic acid (10.72 %). [8] also reported that ethyl acetate extract of Thaumatococcus daniellii leaves have n-hexadecanoic acid (21.62 %), 9-Octadecanamide (17.41 %) and Bis-(2-ethyl hexyl) phthalate as most prominent compounds. However, the presence of these compounds can be influenced by age of plant, geographical location, genetic variation, harvesting time, extraction method as well as storage conditions [17]. Further evaluation of Thaumatococcus daniellii leaf extract will give insight on their therapeutic properties and also address the increasing cases of antimicrobial resistance. Therefore, this study was designed to examine the bioactive compounds of Thaumatococcus daniellii leaf extract by GC-MS.

Materials and methods

Experimental location

The study was carried out at the Department of Agricultural Biochemistry, Gandhi College of Agriculture, Rajasthan in India between the months of April to May, 2024.

Collection of *Thaumatococcus daniellii* leaves and extraction procedure

Fresh leaves of *Thaumatococcus daniellii* was collected from Gandhi College of Agriculture, Rajasthan and it was identified and authenticated by a certified crop taxonomist (Dr. Fredrick Carrick) at Sumitra Research Institute, Gujarat. A voucher specimen number was deposited with the herbarium number QS/2024SD. The collected leaves were sorted, rinsed properly with running tap water to remove dirt's followed by distilled water before it was spread on a plastic sieve for 15 minutes to remove excess water. Thereafter, leaves were air dried for fourteen days and pulverized into powder with an electric blender. Powdered sample was stored in a labeled air tight container and stored at room temperature prior to extraction. 200 grams of powdered sample was macerated into 1000 mL ethanol for two days at room temperature with intermittent stirring. It was later filtered with Whatman filter paper and filtrate was concentrated under a rotary evaporator

maintained at a temperature of 45 °C before sample was transferred immediately to the laboratory for Gas chromatography-mass spectrometry (GC-MS) analysis. Chromatographic analyses of *Thaumatococcus daniellii* extract by Gas chromatography - mass spectrometry (GC-MS)

Chromatographic analyses of *Thaumatococcus daniellii* extract was done using Thermo Specific TSQ Quadrupole GC-MS system (Belgium). The kit was equipped with fused silica capillary column (35 m x 0.30 mm, film thickness 0.20 µm). Analytical conditions of the GC-unit were: Oven temperature: 65 °C, with 2 minutes' initial hold, and then to 250 °C at 6 °C/min, with final hold time of 10 minutes; helium was used as carrier gas at a flow rate of 1 mL/min. The MS chamber was maintained at a EI mode with ionization voltage 70 eV and ion source temperature, 220 °C to maintain precision in results. Percentage composition of each constituent was calculated by integration of the GC peak areas. Retention indices were determined with reference to a homologous series of normal alkanes analyzed under the same conditions. The components of *Thaumatococcus daniellii* extract were identified on the basis of their retention indices. Identification confirmation was by comparison of their mass spectra with published spectra [12] and those of reference compounds from the Library of National Institute of Standard and Technology [13] database.

S/N	Compounds	Retention time (min)	Percentage Area
1	Cis-7-Hexadecenal	6.71	0.12
2	Hexahydrofarnesyl acetone	6.91	0.4
3	13-Tetradecene-11-yn-1-ol	7.83	9.44
4	Hexadecanoic acid	8.08	20.82
5	8-Cyclohexadecene-1-one	8.22	0.3
6	Cis-7-Decene-1-ol	9.17	0.18
7	β-Caryophyllene	9.55	0.55
8	1,8-Cineole	10.4	12.72
9	β-Farnesene	10.82	0.87
10	Ethylbenzene	10.97	0.19
11	β-Linalol	11.11	0.16
12	4-Methyl Octane	12.44	13.81
13	6-Methyl-5-hepta-2-one	12.96	0.17
14	2-Pentylfuran	13.51	0.01
15	α-Terpinolene	13.69	9.02
16	Trans-3(10)-Caren-2-ol	14.55	1.42
17	Palmitoyl Chloride	16.07	0.09
18	β-Cyclocitral	16.56	0.51
19	Methyl nonanoate	16.95	0.06
20	α-Ionone	17.82	0.12
21	α-Cedrene	18.55	0.07
22	Caryophyllene Epoxide	18.92	0.95
23	β-Elemene	19.01	2.41
24	Isopropyl Myristate	20.33	0.17
25	β-Gurjunene	21.62	8.4
26	Isophytol	21.75	0.02
27	γ-Palmito acetone	22.08	0.18
28	Cis-9,12-Octadecadien-1-ol	22.97	0.56
29	Squalene	23.04	9.66
30	Total		93.38
31	No. of Compounds		
32	Monoterpenes	0.91	
33	Sesquiterpenes	8.72	
34	Diterpenes	14.55	
35	Triterpenes	12.62	
36	Apocarotenes	3.40	
37	Non-terpenes	53.18	

Table 1: Compounds identified in ethanol leaf extracts of *Thaumatococcus daniellii* by GC-MS.

The GCMS analysis of *Thaumatococcus daniellii* extracts (Table 1) identified 29 compounds representing 93.38 %. The dominant constituents in *Thaumatococcus daniellii* extracts are: Hexadecanoic acid (20.82 %), 4-Methyl Octane (13.81 %), 1,8-Cineole (12.72 %), Squalene (9.66 %), 13-Tetradecene-11-yn-1-ol (9.44 %), α -Terpinolene (9.02 %) and β -Gurjunene (8.40 %). However, 2-Pentylfuran (0.01 %), Isophytol (0.02 %), Methyl nonanoate (0.06 %), α -Cedrene (0.07 %), β -Linalol (0.09 %), α -Ionone (0.12 %), Cis-7-Hexadecenal (0.12 %) amongst others are the minor compounds. Analysis of the chemical constituents based on the class of compounds revealed the presence of non-terpenes (53.18 %) followed by diterpenes (14.55 %), triterpenes (12.62 %), sesquiterpenes (8.72 %), apocarotenes (3.40 %) and monoterpenes (0.91 %). However, all these compounds recorded have medicinal properties and have been explored in folk medicine in the treatment of various diseases [13]. [14] reported a higher concentration of 21.62 % for hexadecanoic acid in the GC-MS analysis of ethyl acetate extract of *Thaumatococcus daniellii* leaves. [15] reported that 1,2,3,4-Butanetetrol (28.28 %), d-Glycero-d-altro-heptulose (18.14 %), Cyclopentane, 1-ethyl-1-methyl (18.41 %) and 6-Octyl-1-ol, 3,7-dimethyl- (13.97 %) were the most prominent compound in *Thaumatococcus daniellii* leaves. The variation in the results obtained suggests that location, climatic condition, age of plant, genetic variation, harvest time and extraction method could influence the chemical composition of medicinal plants [16, 17]. Hexadecanoic acid, 1,8-Cineole, 4-Methyl Octane and 13-Tetradecene-11-yn-1-ol have been confirmed to possess anti-inflammatory, antibacterial, anti-tumor and immuno-stimulatory properties [18, 19]. α -Terpinolene, β -Caryophyllene and β -Elemene have been reported to exhibit anti-inflammatory, anti-protozoal, antinociceptive and as flavoring agent [20, 21]. β -Linalol, β -Cyclocitral, α -Ionone, α -Cedrene and β -Elemene have been reported to possess antidiarrheal, analgesic, antioxidant, cytotoxic and inhibition of lipid peroxidation [22]. [22, 23] also reported that β -Gurjunene to also have antidiarrheal and antibacterial activity. Cis-9,12-Octadecadien-1-ol, γ -Palmito acetone, Isopropyl Myristate, Cis-7-Hexadecenal, 8-Cyclohexadecen-1-one and Isophytol have been suggested to have antiviral, insecticidal, cardioprotective, antimalarial, anti-rheumatic, antifertility, antinociceptive properties [24, 25]. [26] reported that β -Farnesene and Hexahydrofarnesyl acetone are capable of inhibiting the activities of some pathogenic organisms such as, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Escherichia coli*, *Salmonella spp*, *Microsporum canis*, *Staphylococcus aureus*, *Helicobacter pylori* and *Candida albicans*. Ethylbenzene, 6-Methyl-5-hepta-2-one is reported to have anti-inflammatory, anti-helminthic, antiplatelet, cytotoxicity, angiogenic activities [26].

Conclusion

It was concluded that *Thaumatococcus daniellii* extracts is rich in several bioactive compounds with pharmacological properties such as, antiplatelet, cytotoxicity, angiogenic, antitumor, anti-neoplastic, antiviral, sedative, muscle relaxant, cytotoxic, antioxidant analgesic, inhibition of lipid peroxidation, anti-inflammatory, fungicidal, antiprotozoal, anti-diarrheal activity amongst others. These compounds are generally regarded as safe, effective, eco-friendly and could also serve as natural alternative to antibiotics.

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