



Original Research Article

Bioactive Compounds in *Andrographis echinoides* (L.) Nees. Leaves by GC-MS Analysis

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Abstract	Keywords
<p>The present study investigated the chemical constituents of a traditionally used ethnomedicinal plant <i>Andrographis echinoides</i> Nees. [Syn.: <i>Indoneesiella echinoides</i> (L.) Sreemadh.] using a GC-MS approach. It revealed the existence of more than 17 compounds such as borneol (2.6%), cyclohexanol 2,4 dimethyl phenol (1.89%), 3,4 altroson (3.5%), n-deconoicacid (15.29%), Squalene (22.57%), vitamin E (7.40%), Methoprene (1.53%), 2-nonenol Oxirane, octyl-, 2, 2-cyclopentene-1-undecanoic acid, ketone, 1,5-methylbicyclo [2.1.0] pent-5-ylmethyl (10.61%), 2,5-cyclohexadiene-1,4-dione, 2, 5-dihydroxy-3-methyl-6-(1-methylethyl), bicyclo heptan-3-one, 2,6,6-trimethyl-, (1à,2á,5à) (1.60%), (-)-3-á-Acetoxy-5-etienic acid(3.0%). The medicinal potential of these compounds needs further research which can pave way to further applications and utility of <i>A. echinoides</i> in pharmaceutical field.</p>	<p><i>Andrographis echinoides</i> Bioactive compounds Ethnomedicinal plant Medicinal plant Phytochemicals</p>

Introduction

To overcome health problems the tribes of developing countries primarily rely on herbal medicines which are giving beneficial effect to humans. The herbs are constantly being screened for their biological and pharmacological activities such as anti-diabetic, antioxidant, antimicrobial, and anticancer activities. *Andrographis echinoides* (L.) Nees. (Family: Acanthaceae), also known as *Indoneesiella echinoides* (L.) Sreemadh. which is commonly known as false water willow, is a herb

commonly found throughout India and Sri Lanka. Alagesaboopathi (2014) reported that the whole plant extract is given for the treatment of fever, and leaf-paste is applied externally in snake bite. The antioxidant activity of this plant has been reported by Premkumar et al. (2010). The hydroalcoholic extract of whole plant parts of *A. echinoides* is reported to possess several bioactive compounds and the chemical constituents show anti-inflammatory activity (Shen et al., 2013). Bioactive

compounds of plants generally like phenol, saponins, alkaloids, amino acids and flavonoids are possessing biological activities including anticancer, antifungal, and anti-inflammatory activities (Nadkarni, 1954). Due to uniqueness of curing different ailments, and deficiency of individual parts of *A. echioides*, this plant was selected for the present study to investigate bioactive compounds in the leaf- hydroalcoholic extracts by GC-MS.

Materials and methods

Plant Material and Preparation of Extract

The plant, *A. echioides* (Figs. 1 and 2) used in the study was identified in the ABS Botanical Conservation and Training Centre, India-Southern Circle-Salem, Tamil Nadu, India. The reference material was kept under number [No: AUT/MCAS/035]. Fresh plants were collected randomly from the region of ABS Garden, Salem, Tamil Nadu.

The collected plants were open-air-dried under the shade, pulverized in to a moderately coarse powder (using pestle and mortar). Three-hundred grams of the powdered plants were extracted with methanol (70%) using Soxhlet apparatus for 48 h. A semi-solid extract was obtained after complete elimination of alcohol under reduced pressure. The extract was stored in refrigerator until used.

Gas Chromatograph-Mass Spectrometer (GC-MS) analysis

GC-MS Analysis was carried out on a GC Clarus 500 Perkin Elmer. The GC-MS instrument employing the following conditions: Column Elite-5MS (5% Diphenyl / 95% Dimethyl poly siloxane), $30 \times 0.25\text{mm} \times 0.25\mu\text{m}$ df was used as a Carrier gas 1ml per min, Split: 10:1 and the Detector is Mass detector Turbo mass gold-Perkin Elmer The Software is Turbomass 5.2 and the injection volume $2\mu\text{l}$ was employed injector temperature at 110°C -2 min hold; The oven temperature was programmed from Up to 200°C at the rate of $10^\circ\text{C}/\text{min}$ -No hold Up to 280°C at the rate of $5^\circ\text{C}/\text{min}$ -9 min hold Injector temperature 250°C . Mass spectra were taken at 70ev; a scan interval of 0.5 seconds and fragments from 45 to 450 Da. Total GC running time was 36 min.

Identification of components

Interpretation on mass spectrum GC-MS was conducted using the database of National Institute standard and Technology (NIST) – year 2005. The spectrum of the unknown component stored in the NIST library. The name, molecular weight and structure of the components of the test materials were identified.

Results and discussion

The presence of phytochemicals in hydroalcoholic extracts of *A. echioides* is tabulated and represented by graphical method. Seventeen compounds were identified in the leaf-extract of *A. echioides* by GC-MS analysis. The active principles with their retention time (RT), molecular formula, molecular weight (MW) and concentration (%) are found. The prevailing compound was squalene (22.57%). The chemical compounds are shown in Table 1 and the corresponding chemical shift peaks of the spectrum are shown in Fig. 3.

The compounds identified by GC-MS in hydroalcoholic extract are medicinally valuable and possess various pharmaceutical applications. India has a rich and diverse flora of flowering medicinal plants have been used as a medicine by all cultures from arced times to the recent days. The results of the hydroalcoholic extract of *A. echioides* leaves might be due to the presence of phytochemical constituents in it.

Oxirane, octyl-2, 2-cyclopentene-1-undecanoic acid, ketone, 1,5-methylbicyclo[2.1.0] pent-5-ylmethyl, 2, 5-cyclohexadiene-1, 4-dione, 2,5-dihydroxy-3-methyl-6- (1-methylethyl), bicycle [3.1.1] heptan-3-one, 2,6,6-trimethyl-, (1à,2á,5à), (-)-3-á-acetoxy-5-etienic acid had no activity which was confirmed from Dr. Duke's Phytochemical and Ethnobotanical database (1998) (Table 2). The present study revealed that the various chemical compounds exhibiting higher bioactivity is available. The whole plant has phytochemicals such as saponins, terpinoids, flavonoids, and tannins having anti-inflammatory effects (Shen et al., 2013). Some polyglycosides, flavonoids, tannins, and alkaloids have hypoglycemic. Primary metabolites, for example, sugars, proteins, lipids, and starch are of prime importance and essentially required for growth of plants.

Fig. 1: Habit of the medicinal herb, *Andrographis echioides* L. Nees.



Fig. 2: *Andrographis echioides* L. Nees. – Flowers.



Fig. 3: Chemical compounds in *Andrographis echioides* (L.) Nees. and the corresponding chemical shift peaks in GC-MS spectrograph.

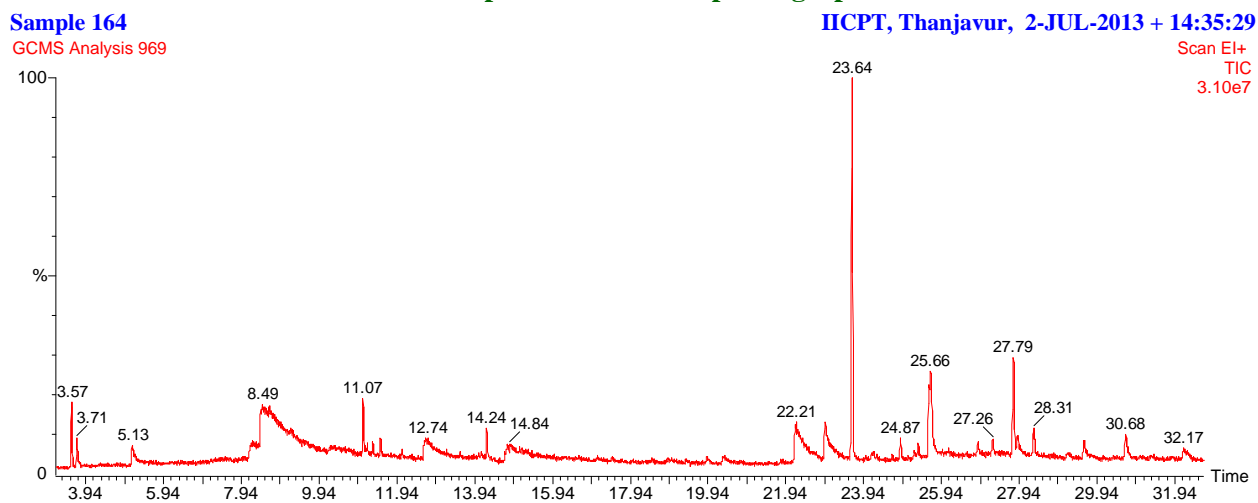


Table 1. Bioactive compounds identified in the hydroalcoholic extract of *Andrographis echioides* (L.) Nees.

Sl. No.	RT	Name of the compound	Molecular formula	MW	Peak Area
1.	3.57	Borneol	C ₁₀ H ₁₈ O	154	2.67
2.	3.71	Cyclohexanol, 2,4-dimethyl-	C ₈ H ₁₆ O	128	1.89
3.	5.13	Phenol, p-tert-butyl-	C ₁₀ H ₁₄ O	150	3.05
4.	8.49	3,4-Altrosan	C ₆ H ₁₀ O ₅	162	15.29
5.	11.07	2-Nonen-1-ol, (E)-	C ₉ H ₁₈ O	142	3.02
6.	12.74	n-Decanoic acid	C ₁₀ H ₂₀ O ₂	172	1.89
7.	14.24	Oxirane, octyl-	C ₁₀ H ₂₀ O	156	1.69
8.	14.94	2-Cyclopentene-1-undecanoic acid, (+)-	C ₁₆ H ₂₈ O ₂	252	1.43
9.	22.21	Ketone, 1,5-dimethylbicyclo[2.1.0]pent-5-yl methyl	C ₉ H ₁₄ O	138	10.61
10.	22.96	2,5-Cyclohexadiene-1,4-dione, 2,5-dihydroxy-3-methyl-6-(1-methylethyl)-	C ₁₀ H ₁₂ O ₄	196	6.40
11.	23.64	Squalene	C ₃₀ H ₅₀	410	22.57
12.	24.87	Bicyclo[3.1.1]heptan-3-one, 2,6,6-trimethyl-, (1à,2á,5à)-	C ₁₀ H ₁₆ O	152	1.60
13.	25.66	4-Hydrazono-5-hydroxyimino-4,5,6,7-tetrahydrobenzofurazan	C ₆ H ₇ N ₅ O ₂	181	13.65
14.	27.79	Vitamin E	C ₂₉ H ₅₀ O ₂	430	7.40
15.	28.31	3-Hexadecyloxy carbonyl-5-(2-hydroxyethyl)-4-methylimidazolium ion	C ₂₄ H ₄₅ N ₂ O ₃	409	2.30
16.	30.68	(-)-3-á-Acetoxy-5-etienic acid	C ₂₂ H ₃₂ O ₄	360	3.00
17.	32.17	Methoprene	C ₁₉ H ₃₄ O ₃	310	1.53

Table 2. Characterization of phytochemical components from the Hydroalcoholic extract of *Andrographis echioides* displaying their bioactivities (Source: Duke, 1998).**

Sl. No.	Name of the compound	Compound Nature	Activity**
1	Borneol	Terpene alcohol	Myorelaxant, antiinflammatory, antipyretic, herbicide, insect repellent, antispasmodic antifeedant, hepatoprotective, fungicide, nematocide, antiyeast, analgesic, antibacterial, tranquilizer, insectifuge, sedative, antisalmonella, antistaphylococcic
2	Cyclohexanol, 2,4-dimethyl-	Aromatic compound	Antimicrobial
3	Phenol, p-tert-butyl-	Phenolic compound	Antimicrobial, antioxidant, anti-inflammatory
4	3,4-Altrosan	Antimicrobial compound	Fungicide
5	2-Nonen-1-ol, (E)-	Alcoholic compound	Antimicrobial
6	n-Decanoic acid	Capric acid	Antimicrobial, insecticide
7	Oxirane, octyl-	Oxirane compound	No activity reported
8	2-Cyclopentene-1-undecanoic acid, (+)-	Fatty acid compound	No activity reported
9	Ketone, 1,5-dimethylbicyclo[2.1.0]pent-5-yl methyl	Ketone compound	No activity reported
10	2,5-Cyclohexadiene-1,4-dione, 2,5-dihydroxy-3-methyl-6-(1-methylethyl)-	Ketone compound	No activity reported
11	Squalene	Triterpene	Pesticide, sunscreen, antibacterial, anticancer, antioxidant, chemopreventive, perfumery, lipoxygenase inhibitor, antitumor
12	Bicyclo[3.1.1]heptan-3-one, 2,6,6-trimethyl-, (1à,2á,5à)-	Ketone compound	No activity reported
13	4-Hydrazono-5-hydroxyimino-4,5,6,7-tetrahydrobenzofurazan	Amino compound	Antimicrobial
14	Vitamin E	Vitamin compound	Hypoglycemic, vasodilator, hepatoprotective, antioxidant, cancer preventive, antibronchitic, antiaging, anticataract, anticoronary, anti-inflammatory, antitumour, hypocholesterolemic, immunostimulant, antidermatitic, analgesic
15	3-Hexadecyloxy carbonyl-5-(2-hydroxyethyl)-4-methylimidazolium ion	Amino compound	Antimicrobial
16	(-)-3-á-Acetoxy-5-etienic acid	Acidic compound	No activity reported
17	Methoprene	Growth regulator	Insecticide compound

Conclusion

From the present study, it is concluded that the hydroalcoholic extract which reveals that *Andrographis echiodes* is highly valuable in medicinal usage for the treatment of various human ailments.

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