

Original Research Article

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Analysis of Medicinally Important Phytochemicals from *Adina cordifolia* Roots

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ABSTRACT

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The present study aimed to investigate the bioactive phytochemical constituents of *Adina cordifolia* through GC-MS analysis. To identify the pharmacologic important compounds present in *Adina cordifolia* roots, extracts were prepared using cold extraction method in different solvents of different polarity, namely chloroform, ethyl acetate, acetone and methanol. Gas chromatography-mass spectrometry (GC-MS) was performed to identify the phytochemicals present in the plant extracts using the National Institute of Standards and Technology (NIST) library. A wide range of fatty acids and plant compounds with antibacterial, antifungal, antiamebic and anti-inflammatory effects were also identified. The study concludes that *Adina cordifolia* contains many biologically important compounds and can therefore be recommended as a medicamentously important plant.

Introduction

Several plants contain a variety of phytomedicinal drugs that are essential in agriculture and medicine. Plants have great potential as medicinal and pharmacopoeial medicines, as a large part of the world's population relies on traditional medicines derived from plants due to the limited availability and high cost of conventional modern medicines. These medicinal plants have provided numerous herbal remedies that play a very important role in the development of new drugs for the treatment and prevention of diseases. Haldu (*Adina cordifolia*) is a deciduous tree of the Rubiaceae family,

subfamily Cinchonoideae native to South Asia, from India and Sri Lanka in the east to southern China and Vietnam. It is found scattered throughout most of the deciduous forests of India and grows in areas up to 900 meters above sea level south of the Himalayas. *A. cordifolia* is an endangered species (www.fes.org.in). *A. cordifolia* has been used since ancient times as an essential ingredient in various antiseptic and antipyretic preparations in Oriental medicine (Chopra *et al.*, 1956). The bark is hot, bitter and pungent, has strengthening, wound healing and aphrodisiac properties and is used for bile problems. The roots are used as an astringent for dysentery (Chanda and Dave, 2009). *A. cordifolia* was

also investigated for its antiulcer potential as its active constituents showed interesting H⁺/K⁺-ATPase inhibitory effects (Kasinadhuni *et al.*, 1999).

Four compounds isolated from a strain of *Adina cordifolia* were identified by spectral and chemical evidence as stigmasta-5, 22-diene-3P-O- α -rhamnopyranosyl-(1-4)-P-dixylopyranoside, α -amyrin, octacosanol and naringenin-7-methyl ether-4'-O- α -rhamnopyranoside (Rokade and Pawar, 2013). In vitro propagation by apical buds is the best means to preserve the endangered species *Adina cordifolia* in the field and produce a large number of plants in a short period of time. *Adina cordifolia* was very well established under in vitro conditions in the presence of MS medium supplemented with 2 mg/L BAP or 0.5 mg/L NAA alone (Raypa *et al.*, 2013). The main compounds identified in the leaf and bark extracts of *Mitragyna parvifolia* (Rubiaceae) were butyric acid, 2-ethylhexyl ester (19.36%), 4-methylmannose (53.13%), mitraphylline (21.59%), isomitraphylline (3.37%), 1,2-hydrazinedicarboxylic acid, diethyl ester (3.50%), α,α -dimethylmuconic acid (22.97%), isobutanoic acid, 2-ethylhexyl ester (43.83%), α -D-glucopyranoside, α -D-glucopyranosyl (27.21%). Compounds found in the leaves of *M. parvifolia* include the pentacyclic oxindole alkaloid mitraphylline, known for its anti-inflammatory and anti-proliferative properties (Vasmatkar *et al.*, 2014).

Materials and Methods

The roots of *Adina cordifolia* were collected from Agroforestry Research Centre (AFRC) Haldi (29. 06441° N, 79.82281° E) G. B. Pant University of Agriculture and Technology, Pantnagar in the month of March.

Experimental work

Preparation of plant material

Roots were washed thoroughly and oven dried at 40 °C for one week. Then dried roots were grounded to make powder in mechanical grinder and stored in air tight container.

Preparation of samples

Plant extracts were prepared in five different solvents viz chloroform, ethyl acetate, acetone, methanol and water. Powdered plant material was used for respective solvent (w:v) (1:4) extraction. The extracts were filtered;

evaporated and dried respective extracts were used for experimentation.

Statistical analysis

All the analyses were performed in triplicates and results were reported as means \pm standard deviation (SD). The significance of differences among treatment means were determined by one way analysis of variance (ANOVA) with a significant level of (p=0.05).

Gas Chromatography based mass spectroscopic analysis of *A. cordifolia* extracts

Interpretation of mass spectrum

The GC-MS analysis was carried out by using GCMS-QP2010 Plus with following experimental conditions: Initial temperature 60°C with RAMP of 3 °C/min, final temperature 210 °C, final hold time 10 min, carrier gas He, flow rate 1 mL/min. Column, silica DB-5, capillary (30nm X 0.25mm ID X 0.25 μ mdf). MS were recorded under electron ionization (EI) condition (70eV) with split mode of 40:1. The compounds were identified by matching their mass spectra with those recorded in NISTMS Wiley Library.

Results and Discussion

GC-MS analysis of *A. cordifolia* root extracts in different solvents viz., Chloroform, Ethyl acetate, Acetone, Methanol and Water

GC- MS analysis of *A cordifolia* root showed the presence of 33 constituents contributing 69.43 – 90.07% of the total extracts were identified. Out of 33 constituents, contributing 69.43% of the chloroform extract, 80.81% of the ethyl acetate extract, 82.77% of the acetonic extract 90.07% of the methanolic extract and 77.77% of the water extract were identified. Persual of Table 1 indicates the names and respective percentage of identified constituents. All the extracts were different in their qualitative and quantitative make-up of major and minor constituents. The dominating constituents in the root extracts of *A cordifolia* were Acetophenone (2.81%), benzoic acid (1.28-2.81%), 1,2,3-trithiolane (6.81%), umbelliferone, o-trimethylsilyl (0.96-4.47%), 7-hydroxycoumarin (28.78-69.58%), n-hexadecanoic acid (0.97-6.77%), ergost-5-en-3.beta.-ol (1.26-4.05%), beta.-sitosterol (1.52-2.28%), gamma.- sitosterol (5.46%), 24-norursa-3,12-diene (3.52%) in respective extracts.

Table.1 Comparative analysis of *Adina cordifolia*'s root Metabolites identified by GC- MS analysis in different solvents

S. No.	Compound	Molecular Formula	% Contribution				
			Chloroform Extract	Ethyl acetate extract	Acetonic extract	Methanol extract	Water extract
1	1-Acetyl-1,2-epoxy	C ₇ H ₁₀ O ₂	-	-	-	0.54	-
2	Acetophenone	C ₈ H ₈ O	2.81	-	-	-	-
3	2-Phenylpropan-2-ol	C ₉ H ₁₂ O	1.87	-	-	-	-
4	Benzoic acid	C ₇ H ₆ O ₂	2.59	2.81	1.52	1.28	-
5	3-Tetradecyn-1-ol	C ₁₄ H ₂₆ O	0.95	-	-	-	-
6	4-Vinyl-2-methoxy-phenol		-	-	0.54	-	0.58
7	Methylhydroxytetrahydrofuroypyridine	C ₉ H ₁₁ NO	-	-	-	-	0.50
8	9,11-Dodecadien-1-ol		-	-	-	-	1.36
9	9-Octadecen-1-ol	C ₁₈ H ₃₆ O	-	-	-	-	4.08
10	5-Hydroxy-1-cyclooctene	C ₈ H ₁₄ O	-	-	-	-	1.36
11	1-[(2-Hydroxyethyl)sulfanyl]-2-Propanol	C ₅ H ₁₂ O ₂ S	-	-	-	28.39	-
12	(Z)-Dodec-5-En-4-olide	C ₁₂ H ₂₀ O ₂	1.10	-	-	-	-
13	6,11-Dimethyl-2,6,10-dodecatrien-1-ol	C ₁₄ H ₂₄ O	1.30	1.70	1.01	-	-
14	3,4-Dihydroxycinnamic acid	C ₉ H ₈ O ₄	-	-	-	1.24	-
15	α-Hexadecene	C ₁₆ H ₃₂	-	-	-	0.70	-
16	1,2,3-Trithiolane	C ₂ H ₄ S ₃	-	-	-	6.18	-
17	Mome inositol	C ₇ H ₁₄ O ₆	-	-	-	1.10	0.37
18	Umbelliferone, O-trimethylsilyl		1.28	3.53	4.47		0.96
19	7-Hydroxycoumarin	C ₉ H ₆ O ₃	28.78	64.52	69.58	43.68	66.20
20	N-Hexadecanoic acid		6.77	2.88	2.15	-	0.97
21	Hexadecanoic acid, trimethylsilyl Ester	C ₁₉ H ₄₀ O ₂ Si	1.85	-	0.62	-	-
22	6,7-Dimethoxybenzo[E]pyran-2 (2h)-One	C ₁₁ H ₁₀ O ₄	-	-	-	0.67	-
23	Campholonic acid	C ₁₀ H ₁₆ O ₂	-	-	-		0.64
24	9,12-Octadecadienoic acid	C ₁₈ H ₃₂ O ₂	1.23	0.50	0.37		-
25	Cis-Vaccenic acid	C ₁₈ H ₃₄ O ₂	1.76				-
26	Squalene	C ₃₀ H ₅₀	1.83	0.66	0.38	0.54	-

27	Loganin aglycone	C ₁₁ H ₁₆ O ₅	-	1.24	2.13	2.40	-
28	Ergost-5-en-3 β -Ol	C ₂₈ H ₄₈ O	4.05	1.26	-	-	-
29	Campesterol	C ₂₈ H ₄₈ O	-	-	-	0.91	-
30	β -Sitosterol	C ₂₉ H ₅₀ O	2.28	1.71	-	1.52	-
31	γ -Sitosterol	C ₂₉ H ₅₀ O	5.46	-	-	-	-
32	α -Amyrenol	C ₃₀ H ₅₀ O	-	-	-	0.92	-
33	24-Norursa-3,12-diene	C ₂₉ H ₄₆	3.52	-	-	-	-
Total			69.43	80.81	82.77	90.07	77.77

The compounds identified in root *A. cordifolia* chloroform extracts are Acetophenone (2.81%), 2-phenylpropan-2-ol (1.87%), benzoic acid (2.59%), (z)-dodec-5-en-4-olide (1.10%), 6,11-dimethyl-2,6,10-dodecatrien-1-ol (1.30%), umbelliferone, o-trimethylsilyl (1.28%), 7-hydroxycoumarin (28.78%), n-hexadecanoic acid (6.77%), hexadecanoic acid, trimethylsilyl ester (1.85%), cis-vaccenic acid (1.76%), Squalene (1.83%), ergost-5-en-3.beta.-ol (4.05%), beta.-sitosterol (2.28%), gamma.-sitosterol (5.46%), 24-norursa-3,12-diene (3.52%), benzoic acid (2.59%), 6,11- dimethyl-2,6,10-dodecatrien-1-ol (1.70%), umbelliferone, o-trimethylsilyl (3.53%), 7-hydroxycoumarin (64.52%), n-hexadecanoic acid (2.88%), loganin aglycone (1.24%), ergost-5-en-3.beta.-ol (1.26%), beta.-sitosterol (1.71%) were reported in *A. cordifolia*'s ethyl acetate extract.

Benzoic acid (1.52%), 6,11-dimethyl-2,6,10-dodecatrien-1-ol (1.01%), umbelliferone, o-trimethylsilyl (4.47%), 7-hydroxycoumarin (69.58%), n-hexadecanoic acid (2.15%), loganin aglycone (2.13%), hexadecanoic acid, trimethylsilyl ester (0.62%) were reported in *A. cordifolia*'s acetonic extract whereas benzoic acid (1.28%), 1-[(2- hydroxyethyl)sulfanyl]-2-propanol (28.39%), 3,4-dihydroxycinnamic acid (1.24%), mome inositol (1.10%), 7-hydroxycoumarin (43.68%), loganin aglycone (2.40%), beta-sitosterol (1.52%) were identified in *A. cordifolia* methanolic extract. 9,11- dodecadien-1-ol (1.36%), 9-octadecen-1-ol (4.08%), 5-hydroxy-1-cyclooctene (1.36%), 7-hydroxycoumarin (66.20%), campholonic acid (0.64%), 2,4-Diisopropenyl-1-methylcyclohexane (0.75%), n-hexadecanoic acid (0.97%), umbelliferone, o- trimethylsilyl (0.96%) were reported in *A. cordifolia*'s water extract.

9 octadecanoic acid methyl ester, beta sitosterol trimethyl silyl ether etc. identified in present study have been reported to use as starting material for the synthesis of industrially important component of natural pesticide (Xu *et al.*, 2018), possess antifungal activity, astringent power, antipyretic property, inflammatory effect, analgesic effect, vasodilatory effect, antimicrobial property, antiageing and antidiabetic property, antioxidant activity, adjuvant activities, antiarthritic, antidiarrhoeal and antiviral effect (Rathna *et al.*, 2016; Fujita *et al.*, 1972; Lorgeril *et al.*, 2001; Aparna *et al.*, 2012; Kanthal *et al.*, 2014; Duke and Beckstrom-Sternberg, 1994).

These findings suggest that this plant possesses the potential to serve as a valuable natural reservoir for

various industrially significant phytoconstituents. Additionally, it could be utilized for the production of herbal remedies and as a source of natural antioxidants.

Benzene and ethyl acetate extracts from the root bark of *Adina cordifolia* had good antiamebic activity, with IC50 values of 2.92 and 2.50 mg/ml, respectively (Dalu *et al.*, 2021).

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Author Contributions

Pratima Raypa: Investigation, formal analysis, writing—original draft. A. K. Verma: Validation, methodology, writing—reviewing. Salil Tewari:—Formal analysis, writing—review and editing. Ashutosh Dubey: Investigation, writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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