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VOLATILE PHYTOCONSTITUENT PROFILE OF *Argemone mexicana* L. LEAVES AND PHARMACOLOGICAL IMPORTANCE

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ABSRACT

The current study was performed to identify the bioactive compounds from methanol extract of *Argemone mexicana* leaves by Gas Chromatography and Mass Spectrum (GC-MS) analysis and to review their medicinal applications to mankind. The *Argemone mexicana* leaves extract was prepared with methanol and analyzed by GC-MS using Perkin Elmer Elite on 5 capillary column. Total 22 compounds were identified by GC-MS analysis and cycloserine, 2-Methoxy-4-vinylphenol, 5-hydroxymethyl 2-furfural, D-Allose, 3-Deoxy-d-mannoic lactone, Palmitic acid and Tetradecanoic being the major compounds with good medicinal applications as an antibiotic to treat multidrug resistant tuberculosis, antiseptic, treating anxiety disorders, chronic schizophrenic patients, antimicrobial, antioxidant, antifungal, anti-inflammatory, anticancer, anti-nociceptive and analgesic agent. In our earlier lab report, the methanolic extract of *A.mexicana* leaves posses anti-urolithiatic effects on pre-prepared calcium oxalate crystals by different *In vitro* assays such as nucleation assay, microscopic observation and aggregation assay. The research paper concluded that, *Argemone mexicana* leaves contained n-Hexadecanoic acid; cis,cis,cis-7,10,13-Hexadecatrienal; and 3,7,11,15-Tetramethyl-2-hexadecen-1-ol as major volatile constituents which will be used against various diseases. These result findings will help the society to find exact fit model of molecules through *In silico* approach in the drug discovery laboratory. Further the authors may be tested the efficacy of these compounds and non-volatile molecules from *A.mexicana* leaves in animal models against various diseases and disorders in future.

KEYWORDS: ***Argemone mexicana* L. Phytoconstituents, Gas chromatography and Mass Spectroscopy, Hexadecanoic acid.**

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INTRODUCTION

The genus *Argemone* belongs to Papaveraceae family and it consists about 32 species. The *Argemnone mexicana* is a native plant of Mexico. The plant also known as mexican prickly poppy, mexican poppy and prickly poppy. In India, it is known by different names based on the local language Hindi: Satyanashi, Kannada: Datturigidda, Konkani: Phirangi dhutro, Malayalam: Ponnummattu, Bengali: Siyal-Kanta, Manipuri: Khomthongpee, Sanskrit: Kshirini, Swarnakshiri Tamil: Kutiyotti Ponnummuttai, Telugu: Brahmadandi or Mullupucha, Marathi: Firangi dhotra[4] It is an annual herb grows in the moist soil region of India. The *A.mexicana* starts budding at the early winter and disappears during the summer. It grows up to 150 cm with a slightly branched tap roots. The stem is extremely prickly and the flowers are yellow in colour. The *A.mexicana* is well known as a medicinal source in ayurveda, unani and homeopathy[1]. The plant parts contain different chemical compounds and secondary metabolites[2]. There are wide range of medicinal uses are in the all the parts of this plant, whereas leaves are used for wound healing activity, anti-pyretic, anti-inflammatory, anti-plasmodial, anti-malarial, anodyne, expectorant, hepatoprotective, diuretic activity. Roots are used as a diuretic and chronic skin disease curing. Seeds are used for larvicidal activity, laxative, emetic, expectorant and demulcent[3]. The earlier report stated that the MeOH extract of *A. mexicana* leaves has anti-urolithiatic activity[4]. The aim and objective of current research is to support the earlier research done by the author, therefore *A. mexicana* is taken and examined for its volatile phytochemical profile.

MATERIALS AND METHODS

Plant Material and Extraction

A. mexicana leaves were collected in and around Rangareddy District, Telangana State and authenticated by Dr. G.V.S. Murthy, Scientist F, Botanical Survey of India, Southern Regional Circle, Coimbatore, Tamil Nadu and the voucher specimen was deposited (Vide No: BSI/SRC/5/23/2013-14/Tech./1855). The fresh leaves were separated and washed thoroughly in tap water then the leaves were shade dried for a week[5]. The dried leaves (approximately 1 kg) were pulverized in an electrical grinder from which 500 g of dry powder was taken for solvent extraction using Soxhlet apparatus with eight to ten times suctions. The solvent used for the extraction was methanol. The leaf powder was packed in Soxhlet apparatus for 24 hours and the yield was 9 g per 100 g powder[6].

Gas Chromatography and Mass Spectroscopy Analysis of A. mexicana leaves extract

The investigation of phytoconstituents in methanol extract of *A. mexicana* leaves was carried out at the Centre for Advanced Research in Indian System of Medicine (CARISM) using a PerkinElmer Clarus 500 mass spectrometer. The column used was Elite-5 Capillary Column and column length 30 m and column ID 250 µm. Column was composed of Cross bond 5% Phenyl and 95% Dimethyl polysiloxane. The Helium was used as a gas carrier with the flow rate of 1 ml/min. a sample of 1 µl was injected into injector and the injector temperature was maintained up to 280 °C. Initial oven temperature was programmed at 60 °C then increased to 150 °C and then brought up to 280 °C. The system total run time was 54.5 minutes. The mass range was 40-450amu and temperature of MS transfer line was maintained at 200 °C and source temperature was maintained at 160 °C. The type of ionization used for analysis was electron ionization (EI) with electronic energy at 70ev. The Turbo-mass version 5.2.0 software was used to measure the peak areas and data processing. All the identified peak values of *A. mexicana* leaves were compared with known compound data base stored in NIST library[7].

RESULTS AND OBSERVATION

GC-MS Analysis

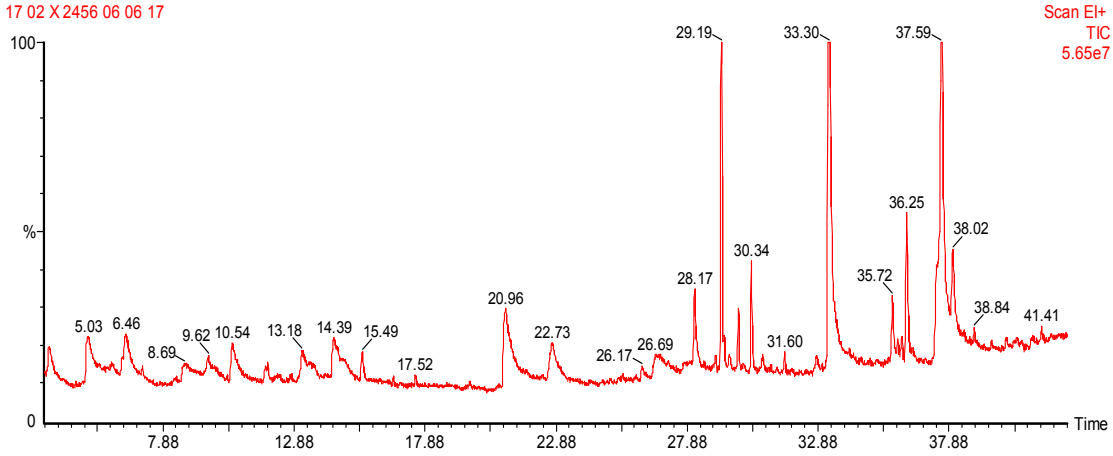
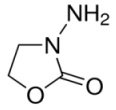
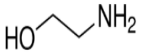
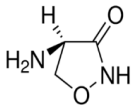
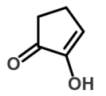
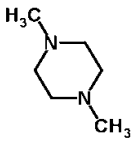
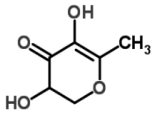
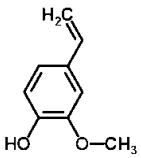
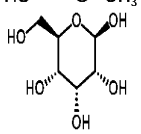
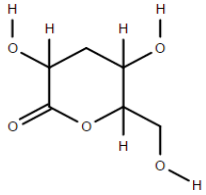
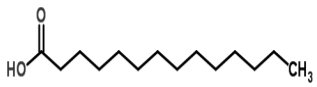
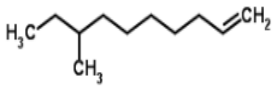
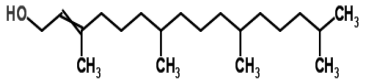
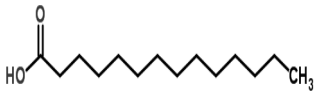
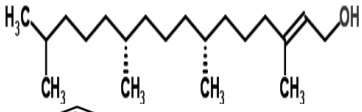
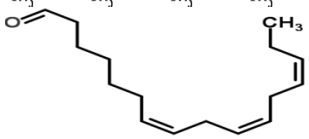
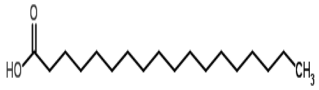
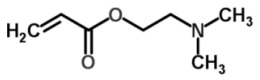


Figure 1
GC–MS Spectral studies of *A. mexicana L.* leaves

mexicana leaves extracted in methanol upon GC-MS analysis is identified with 22 compounds. The chromatogram presents 5 prominent peaks [Figure 1] at retention time range from 5.03 to 37.59 minutes. The compounds are Methanamine, N-hydroxy-N-methyl, n-Hexadecanoic acid, 3,7,11,15-Tetramethyl-2-hexadecen-1-ol, cis,cis,cis-7,10,13-Hexadecatrienal, Phytol. The peak is at 33.30 retention time which is having highest peak area 32.3284% due to n-Hexadecanoic acid (Palmitic acid). The detailed tabulation of identified compounds is presented in the Table 1.

Table 1
Phytochemical profile of *A. mexicaan L* Leaves extract

Peak	IUPAC Name, Chemical Formulaand Molecular weight	Chemical Structure	Retention time	%Peak Area
1.	Name: 3-Amino-2-oxazolidinone Formula: $C_3H_6N_2O_2$ MW: 102		3.56	1.8647
2.	Name: Methanamine, N-hydroxy-N-methyl Formula: C_2H_7NO MW: 61		5.03	5.8665
3.	Name: Cycloserine Formula: $C_3H_6N_2O_2$ MW: 102		5.91	0.9456
4.	Name: 2-Cyclopenten-1-one, 2-hydroxy Formula: $C_5H_6O_2$ MW: 98		6.46	1.8222
5.	Name: 1,6-Anhydro-2,4-dideoxy-á-D-arabo-hexopyranose Formula: $C_6H_{10}O_3$ MW: 130		8.69	3.2540
6.	Name: Piperazine, 1,4-dimethyl- Formula: $C_6H_{14}N_2$ MW: 114		9.62	1.7864
7.	Name: 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- Formula: $C_6H_8O_4$ MW: 144		11.80	0.3932
8.	Name: 2-Furancarboxaldehyde, 5-(hydroxymethyl)- Formula: $C_6H_6O_3$ MW: 126		14.39	2.0706
9.	Name: 2-Methoxy-4-vinylphenol Formula: $C_9H_{10}O_2$ MW: 150		15.49	0.9899
10.	Name: D-Allose Formula: $C_6H_{12}O_6$ MW: 180		22.73	3.7906
11.	Name: 3-Deoxy-d-mannoic lactone Formula: $C_6H_{10}O_5$ MW: 162		26.69	2.9923
12.	Name: Tetradecanoic acid Formula: $C_{14}H_{28}O_2$ MW: 228		28.17	2.5040

Peak	IUPAC Name, Chemical Formulaand Molecular weight	Chemical Structure	Retention time	%Peak Area
13.	Name: 1-Decene, 8-methyl- Formula: $C_{11}H_{22}$ MW: 154		28.98	0.4251
14.	Name: 3,7,11,15-Tetramethyl-2-hexadecen-1-ol Formula: $C_{20}H_{40}O$ MW: 296		29.19	8.8135
15.	Name: n-Hexadecanoic acid Formula: $C_{16}H_{32}O_2$ MW: 256		33.29	32.2384
16.	Name: 1-Nonadecanol Formula: $C_{19}H_{40}O$ MW: 284		35.72	1.8854
17.	Name: 1,5,9,13-Tetradecatetraene Formula: $C_{14}H_{22}$ MW: 190		35.92	0.3367
18.	Name: Phytol Formula: $C_{20}H_{40}O$ MW: 296		36.26	4.7501
19.	Name: cis,cis,cis-7,10,13-Hexadecatrienal Formula: $C_{16}H_{26}O$ MW: 234		37.59	15.9434
20.	Name: Octadecanoic acid Formula: $C_{18}H_{36}O_2$ MW: 284		38.02	2.4614
21.	Name: 2-Propenoic acid, 2-(dimethylamino)ethyl ester Formula: $C_7H_{13}NO_2$ MW: 143		40.05	0.3252
22.	Name: 9,12,15-Octadecatrienal Formula: $C_{18}H_{30}O$ MW: 262		41.41	0.4418

The molecules identified with respective KI values of the peak and similarity matches in comparison with NCBI database.

DISCUSSION

A. mexicana have been used as a traditional medicinal plant from ancients, the leaves extract is prepared with methanol and analysed using GC-MS to determine the bioactive compounds in the extract. Among the 22 compounds as listed in the Table 1, Cycloserine is widely used as an antibiotic to treat the multi-drug resistant tuberculosis[8]. It is marketed in the trade name of Seromycin[9] and is also used as an antiseptic in treating urinary tract infections[10-12], treating anxiety disorders[13], and for chronic schizophrenic patients[14]. Piperazines are generally used for manufacturing of plastic, resins, pesticides and bake fluids. The compound 5-hydroxymethyl 2-furfural is an aromatic aldehyde having a capacity to modify the intracellular sickle hemoglobin and inhibits sickling of red blood cells (RBCs)[15-16] and also having an hepatocyte protective effect and anti-apoptotic mechanism[17]. 2-Methoxy-4-vinylphenol is a phenolic compound having various medicinal properties such as antimicrobial, antioxidant, anti-inflammatory and analgesic[18-19]. The rare sugar D-Allose is proved for its inhibitory effect on cancer cell proliferation[20], neuroprotective effect against retinal ischemia[21-23]. 3-Deoxy-d-mannoic lactone is having anti-fungal effect[24]. Tetradecanoic acid has cancer preventing capability[25]. 1-Decene and 8-methyl are used in the detergents and cleaning compositions[26]. Phytol or 3,7,11,15-Tetramethyl-2-hexadecen-1-ol has been used as an anti-nociceptive and antioxidant[27-29]. The compound n-Hexadecanoic acid is also known as Palmitic acid, it has many medicinal properties such as anti-inflammatory[30], anti-microbial[31] and in production of biodiesel[32]. Octadecanoic acid is also known as stearic acid, used in production of soaps detergents, cosmetics and also used as an antibacterial and antifungal agent[33].

CONCLUSION

Based on this research, it was concluded that the GC-MS analysis of *A. mexicana* leaves extracted in methanol having different kind of bioactive compounds, which are already proved for various medicinal uses. This research also supports the

earlier research on *in vitro* anti-urolithiasis, that the single or combination of any of these identified compounds may have anti-urolithiasis activity.

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CONFLICT OF INTEREST

Conflict of interest declared none.

REFERENCES

1. Dey NR, Das KC, Rai Y. *Argemone mexicana*: A multicentric double blind Homoeopathic Pathogenetic Trial (Drug Proving) carried out by CCRH. Ind J Res Homoeopathy. 2008 Jan 1;2(1):13.
2. Sharanappa R, Vidyasagar GM. Plant profile, phytochemistry and pharmacology of *Argemone mexicana* Linn. A review. Int J Pharm Pharm Sci. 2014;6:45-53.
3. Rajvaidhya S, Nagori BP, Singh GK, Dubey BK, Desai P, Jain S. A review on *Argemone mexicana* linn.-an Indian medicinal plant. Ind J Pharm Sci Res. 2012 Aug 1;3(8):2494.
4. Kiran Chilivery R, Alagar S, P Darsini T. In Vitro Anti-Urolithiasis Potentials of *Argemone mexicana* L. Leaves. Curr Clin Pharmacol. 2016 Nov 1;11(4):286-90.
5. Agarwal K, Varma R. In-vitro Calcium oxalate crystallization inhibition by *Achyranthes aspera* L. and *Bryophyllum pinnatum* Lam. Br J Pharm Res. 2015 Jan 1;5(2):146.
6. Yadav SA, Raj AJ, Sathishkumar R. In vitro antioxidant activity of *Barleria noctiflora* L. f. Asian Pac J Trop Biomed. 2012 Feb 1;2(2):S716-22.
7. Alagar Yadav S, Ramalingam S, Jabamalai Raj A, Subban R. Antihistamine from *Tragia involucrata* L. leaves. J Complement Integr Med. 2015 Sep 1;12(3):217-26.
8. Desjardins CA, Cohen KA, Munsamy V, Abeel T, Maharaj K, Walker BJ, Shea TP, Almeida DV, Manson AL, Salazar A, Padayatchi N. Genomic and functional analyses of *Mycobacterium tuberculosis* strains implicate ald in D-cycloserine resistance. Nat Gen. 2016 May 1;48(5):544-51.
9. Patterson ME, Rosenfelt DJ. Justifying high drug prices within the context of value: Biologics versus generics.
10. El Sakka N, Gould IM. Role of old antimicrobial agents in the management of urinary tract infection. Expert Rev Clin Pharmacol. 2016 Aug 2;9(8):1047-56.
11. Fairbrother RW, Garrett G. Treatment of urinary infections with cycloserine. Brt Med J. 1960 Oct 22;2(5207):1191.
12. Kaltenis P. Cycloserine as a urinary tract antiseptic. Int Urol Nephrol. 1986 Jun 1;18(2):125-30.
13. Rodrigues H, Figueira I, Lopes A, Gonçalves R, Mendlowicz MV, Coutinho ES, Ventura P. Does D-cycloserine enhance exposure therapy for anxiety disorders in humans? A meta-analysis. PloS one. 2014 Jul 3;9(7):e93519.
14. Van Berckel BN, Evenblij CN, Van Loon BJ, Maas MF, Van der Geld MA, Wynne HJ, Van Ree JM, Kahn RS. D-cycloserine increases positive symptoms in chronic schizophrenic patients when administered in addition to antipsychotics: a double-blind, parallel, placebo-controlled study. Neuropsychopharmacol. 1999 Aug 1;21(2):203-10.
15. Abdulmalik O, Safo MK, Chen Q, Yang J, Brugnara C, Ohene-Frempong K, Abraham DJ, Asakura T. 5-hydroxymethyl-2-furfural modifies intracellular sickle haemoglobin and inhibits sickling of red blood cells. Br J Haematol. 2005 Feb 1;128(4):552-61.
16. Nässberger L. Influence of 5-hydroxymethylfurfural (5-HMF) on the overall metabolism of human blood cells. Human Exp Toxicol. 1990 Jul;9(4):211-4.
17. Wang MY, Zhao FM, Peng HY, Lou CH, Li Y, Ding X, Yu XY, Yang GM, Xu DQ, Jiang LH, Zhang X. Investigation on the morphological protective effect of 5-hydroxymethylfurfural extracted from wine-processed *Fructus corni* on human L02 hepatocytes. J Ethnopharmacol. 2010 Jul 20;130(2):424-8.
18. Feng S, Zeng W, Luo F, Zhao J, Yang Z, Sun Q. Antibacterial activity of organic acids in aqueous extracts from pine needles (Pinus massoniana Lamb.). Food Sci Biotechnol. 2010 Feb 1;19(1):35-41.
19. Vadivel E, Gopalakrishnan S. GC-MS analysis of some bioactive constituents of *Mussaenda frondosa* LINN. Inter J Pharm Bio Sci. 2011;2:313-20.
20. Sui L, Dong Y, Watanabe Y, Yamaguchi F, Hatano N, Tsukamoto I, Izumori K, Tokuda M. The inhibitory effect and possible mechanisms of D-allose on cancer cell proliferation. Int J Oncol. 2005 Jan 1;27(4):907-12.
21. Hirooka K, Miyamoto O, Jinming P, Du Y, Itano T, Baba T, Tokuda M, Shiraga F. Neuroprotective effects of d-allose against retinal ischemia–reperfusion injury. Invest Ophthalmol Vis Sci. 2006 Apr 1;47(4):1653-7.
22. Hossain MA, Izuishi K, Tokuda M, Izumori K, Maeta H. d-Allose has a strong suppressive effect against ischemia/reperfusion injury: a comparative study with allopurinol and superoxide dismutase. J Hepatobillary Pancreat Sci. 2004 Jun 1;11(3):181-9.
23. Nakamura T, Tanaka S, Hirooka K, Toyoshima T, Kawai N, Tamiya T, Shiraga F, Tokuda M, Keep

RF, Itano T, Miyamoto O. Anti-oxidative effects of d-allose, a rare sugar, on ischemia-reperfusion damage following focal cerebral ischemia in rat. Neurosci Lett. 2011 Jan 3;487(1):103-6.
24. Sharma MD, Rautela I, Sharma N, Gahlot M, Koshy EP. GC-MS analysis of Phytocomponents in juice sample of Indian cane: Saccharum barberi. Int J Pharma Sci Res. 2015;6(12):5147-53.
25. Morris JB. Food, industrial, nutraceutical, and pharmaceutical uses of sesame genetic resources. Trends in new crops and new uses. 2002:153-6.
26. Potgieter IH, Buck AE, Betts MJ, inventors; Sasol Technology (Proprietary) Limited, assignee. Detergent and cleaning compositions derived from new detergent alcohols. United States patent US H1,818. 1999 Nov 2.
27. de Moraes J, de Oliveira RN, Costa JP, Junior AL, de Sousa DP, Freitas RM, Allegretti SM, Pinto PL. Phytol, a diterpene alcohol from chlorophyll, as a drug against neglected tropical disease Schistosomiasis mansoni. PLoS Negl Trop Dis. 2014 Jan 2;8(1):e2617.
28. Santos CC, Salvadori MS, Mota VG, Costa LM, de Almeida AA, de Oliveira GA, Costa JP, de Sousa DP, de Freitas RM, de Almeida RN. Antinociceptive and antioxidant activities of phytol in vivo and in vitro models. Neurosci J. 2013 Jun 11;2013.
29. Zeb A, Ahmad S, Ullah F, Ayaz M, Sadiq A. Anti-nociceptive activity of ethnomedicinally important analgesic plant Isodon rugosus Wall. ex Benth: Mechanistic study and identifications of bioactive compounds. Front Pharmacol. 2016;7.
30. Aparna V, Dileep KV, Mandal PK, Karthe P, Sadasivan C, Haridas M. Anti-Inflammatory Property of n-Hexadecanoic Acid: Structural Evidence and Kinetic Assessment. Chem Biol Drug Des. 2012 Sep 1;80(3):434-9.
31. Ibrahim HR, Kato A, Kobayashi K. Antimicrobial effects of lysozyme against gram-negative bacteria due to covalent binding of palmitic acid. J Agric Food Chem. 1991 Nov;39(11):2077-82.
32. Carmo AC, de Souza LK, da Costa CE, Longo E, Zamian JR, da Rocha Filho GN. Production of biodiesel by esterification of palmitic acid over mesoporous aluminosilicate Al-MCM-41. Fuel. 2009 Mar 31;88(3):461-8.
33. Agoramoorthy G, Chandrasekaran M, Venkatesalu V, Hsu MJ. Antibacterial and antifungal activities of fatty acid methyl esters of the blind-your-eye mangrove from India. Braz J Microbiol. 2007 Dec;38(4):739-42.

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