

GC-MS ANALYSIS OF BIOACTIVE COMPOUNDS OF ETHANOLIC EXTRACT OF *ABELMOSHCUS FICULNEUS (L.) WIGHT & ARN.*

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ABSTRACT

In the present work Gas chromatography and Mass spectroscopy (GC-MS) analysis of ethanolic extract of *Abelmoschus ficulneus* (L.) Wight & Arn belonging to the family Malvaceae was carried out. GC MS analysis of ethanol extract was done by standard protocol using the equipment Perkin-Elmer Gas Chromatography-Mass Spectrometry, while the mass spectra of the compounds found in the extract was matched with the National Institute of Standards and Technology (NIST) library. GC-MS analysis of ethanolic extracts of stem, leaf, root and fruit exhibited numerous peaks in different retention time. The stem extract represented the presence of 20 compounds, leaf, root and fruit extracts represented the presence of 19, 30 and 12 compounds. Root extracts exhibited maximum number chemical compounds present in the plant. The bioactive compounds present in the plants have chemopreventive, anticancer, anti-microbial activity, antioxidant and antidiabetic activity due to the presence of secondary metabolites in the ethanolic extract. However, isolation of individual phytoconstituents may proceed to find a novel drug in a pharmaceutical industry.

Keyword: Gas chromatography and Mass spectroscopy, *Abelmoschus ficulneus*, ethanol extract and NIST library.

INTRODUCTION

Plants are a rich source of secondary metabolites with interesting biological activities. In general, these secondary metabolites are an important source with a variety of structural arrangements and properties [1]. Medicinal herbs and alternative medicines are safer, effective, available and cheap alternatives in comparison to synthetic therapy [2]. Secondary metabolites are taxonomically and chemically diverse compounds with obscure function. They are widely used in human therapy, veterinary, agriculture, scientific research and countless other areas [3]. GC-MS is considered as one of the best technique for identifying the constituents of volatile matter, long and branched chain hydrocarbons, alcoholic acids esters and others substances [4]. In nature, there are a huge variety of herbs, having medicinal properties and they are used to prepare the herbal medicines. They can be used directly in the form of extracts or tea or used to produce the drugs. Several herbs consist of powerful

ingredients, which are helpful to cure a number of health problems. The literature search reveals that still no work has been done on this plant part. Hence this work was carried out to profile chemical compounds from ethanol extract of *A. ficulneus*.

MATERIALS AND METHODS

Materials

The experimental plant selected for the present study is *Abelmoschus ficulneus* (L.) Wight & Arn. belongs to the family Malvaceae. The plant material was collected from Manonmaniam Sundaranar University campus, Tirunelveli district, Tamil Nadu. The taxonomic features collected from the species have been confirmed with the 'Flora of Presidency of Madras' [5].

Preparation of Plant Powder

The stem, leaf, root and fruit of *Abelmoschus ficulneus* were collected and washed thoroughly. After that the stem, leaf, root and fruits were cut into pieces and shade dried at room temperature (25-30°C), for about two weeks. The

dried material was ground to fine powder for further analysis.

Extraction

About 30 gm of plant powder was taken in a digestion flask fitted to the Soxhlet apparatus and extracts were obtained successively with ethanol. The aqueous extract was prepared directly by boiling the powder with distilled H₂O. These extracts were concentrated and kept in brown bottles for further use. The plant extracts were off with distillation apparatus and yielded quantities of (stem, leaf, root and fruit) extracts in different solvents were obtained.

Gas Chromatography-Mass Spectrometry Analysis

The GC-MS analyses were carried out in a shimadzu GC-MS-QP 2010 gas chromatograph fitted with a DBI (Methylphenylsiloxane, 30 m x0.25 mm id.d) capillary column. Carrier gas, helium with a flow rate of 0.7 ml/min; column oven temperature 70°C, 5 min in 180°C, 180-260°C at 3°C/min, 5 min in 60°C, 260-280°C at 0.2°C/min and finally 5 min in 280°C; injector temperature, 280°C detector temperature 290°C, volume injected, 1 µL of TMS ether derivatives in *n*-hexane (2%); split ratio, 3:0. The MS operating parameters were as follows: ionization potential 70 eV; ion source temperature

200°C; quadrupole 100°C amu, eV voltage 3000 volts.

Compound Identification

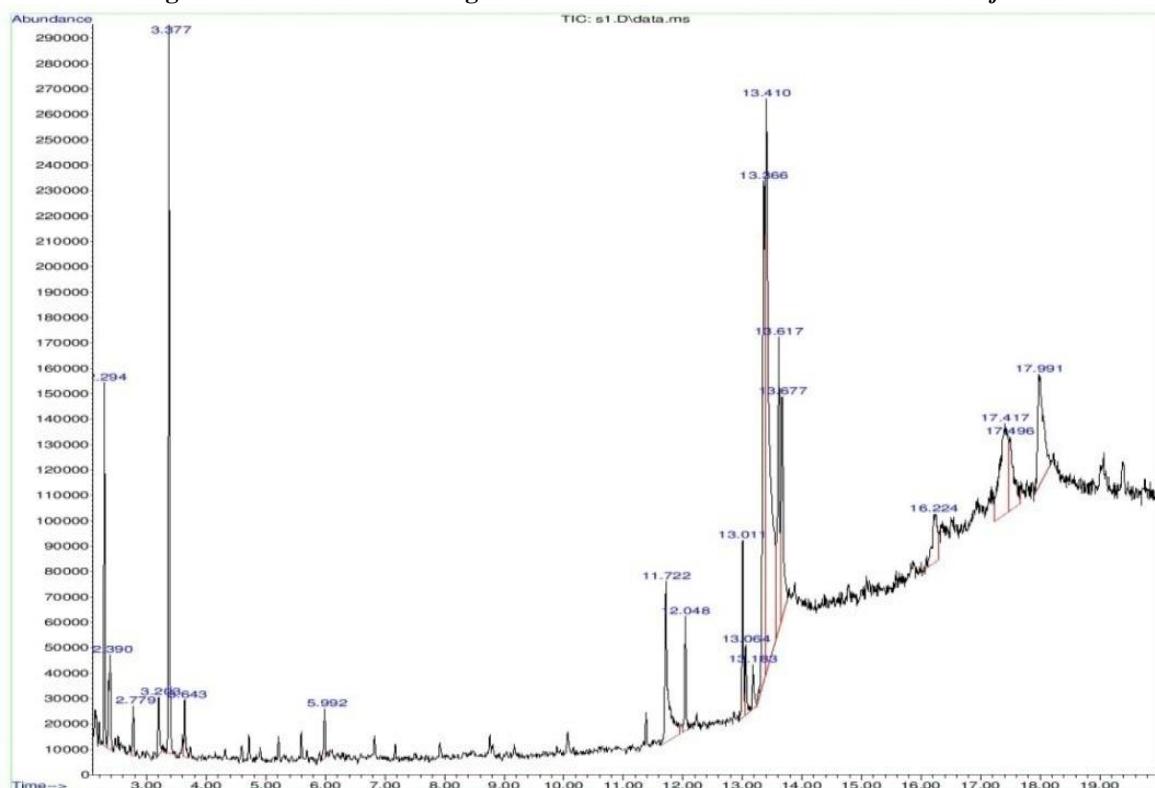
Components of the ethanol extracts were identified by comparison of their mass spectra and retention indices with those published in the literature and contained in the NIST '98 MS computer library (Wiley).

RESULT AND DISCUSSION

Gas chromatography-mass spectroscopic spectra analysis

Gas chromatography – mass spectrometry (GC-MS) is a method that combines the features of gas-liquid chromatography and mass spectrometry to identify different substances within a test sample [6]. In the last few years, GC-MS has become firmly established as a key technological platform for secondary metabolite profiling in both plant and non-plant species [7]. GC-MS analysis is an interesting tool to evaluate a number of active bio components used in cosmetic, pharmaceutical and food industry [8]. The compounds present in the ethanol extracts of stem, leaf, root and fruit of *A. ficalneus* were identified after the comparison of the mass spectra with NIST library by GC-MS analysis. The active principles with their retention time (RT), molecular formula, molecular weight and structure in various extracts of *A. ficalneus* were presented.

Figure 1: GC-MS Chromatogram of ethanol stem extracts of *Abelmoschus ficalneus*

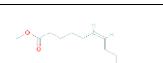
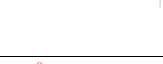


GC-MS spectrum of ethanol extract stem of *A. ficalneus* showed 20 different major peaks which indicated the presence of 20 compounds (Figure 1 & Table1). The prevailing compounds in ethanol extract were 3-Carene (4.48%), Limonene (2.12%), Dodecane, 1-chloro- (0.72%), 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- (1.02%), Isoborneol (8.54%), Naphthalene (0.88%), Alloaromadendrene (0.78%), n-Hexadecanoic acid (5.36%), Hexadecanoic acid, ethyl ester (1.78), 9,12-Octadecadienoic acid, methyl ester (2.57%), 6-

Octadecenoic acid, methyl ester, (Z)- (1.30%), 1,2-15,16-Diepoxyhexadecane (0.77%), 9,12-Octadecadienoic acid (Z,Z)- (11.18%), 9,17-Octadecadienal, (Z)- (25.44%), 9,12-Octadecadienoic acid, ethyl ester (6.65%), 13-Tetradecene-11-yn-1-ol (5.43%), 1H-Indene, 5-butyl-6-hexyloctahydro-(2.80%), Silicic acid, diethyl bis(trimethylsilyl) ester (7.87%), 2-Ethylacridine (3.67%), Ethanone, and 2-(2-benzothiazolylthio)-1-(3,5-dimethylpyrazolyl)-(6.63%).

Table 1: GC-MS analysis of ethanol extracts of stem of *Abelmoschus ficalneus*

S. No	Retention time	Name of the compound	Molecular formula	Molecular weight	Structure	Biological activity
1.	2.295 min	3-Carene	C ₁₀ H ₁₆	136.238 g/mol		Anti-inflammatory, Analgesic, Antiseptic, Antibacterial, Antipyretic
2.	2.389 min	Limonene	C ₁₀ H ₁₆	136.238 g/mol		Antimicrobial activity, Antinociceptive activity, Antioxidant activity, Anticancer activity, Insecticidal activity
3.	2.777 min	Dodecane, 1-chloro-	C ₁₂ H ₂₅ Cl	204.782 g/mol		Antibacterial, Antifungal, Antioxidant.
4.	3.203 min	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	C ₆ H ₈ O ₄	144.126 g/mol		Astringent, Anti-inflammatory, Antibacterial, Antifungal, Diuretic.
5.	3.373 min	Isoborneol	C ₁₀ H ₁₈ O	154.253 g/mol		Antiviral Activity, Antibacterial and Antifungal activity
6.	3.647 min	Naphthalene	C ₁₀ H ₈	128.174 g/mol		Anti-inflammatory activities, Antibacterial, Antiprotozoals, Antineoplastics, Antiviriotics,
7.	5.992 min	Alloaromadendrene	C ₁₅ H ₂₄	204.357 g/mol		Antioxidant, Antimicrobial activity, Anti-cariogenic activity
8.	11.722 min	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256.43 g/mol		Antimicrobial activities, Anti-inflammatory

9.	12.043 min	Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284.484 g/mol		Anti-inflammatory, Anesthetic, Antiviral and Antineurotic.
10.	13.008 min	9,12-Octadecadienoic acid, methyl ester	C ₁₉ H ₃₄ O ₂	294.479 g/mol		Antipyretic, Antiparasitic, Antimalarial, Antibacterial, Antifungal and Antiviral
11.	13.064 min	6-Octadecenoic acid, methyl ester, (Z)-	C ₁₉ H ₃₆ O ₂	296.495 g/mol		Anti-cancer, Antifungal, Anti-cancer, Anti-inflammatory and Hypocholesterolemic
12.	13.178 min	1,2-15,16-Diepoxyhexadecane	C ₁₆ H ₃₀ O ₂	254.414 g/mol		Antibacterial, Antimicrobial, Antioxidant, Anticancer Activity
13.	13.367 min	9,12-Octadecadienoic acid (Z,Z)-	C ₁₈ H ₃₂ O ₂	280.452 g/mol		Antibacterial, Anti-inflammatory, Antioxidant
14.	13.405 min	9,17-Octadecadienol, (Z)-	C ₁₈ H ₃₂ O	264.453 g/mol		Antioxidant, Antiviral, Nematicidal, Antifungal, Insecticidal
15.	13.613 min	9,12-Octadecadienoic acid, ethyl ester	C ₂₀ H ₃₆ O ₂	308.506 g/mol		Antioxidant, Anti-inflammatory, Antiarthritic activity
16.	13.679 min	13-Tetradecene-11-yn-1-ol	C ₁₄ H ₂₄ O	208.345 g/mol		Anti-ulcer, Anti-inflammatory, Antimicrobial
17.	16.223 min	1H-Indene, 5-butyl-6-hexyloctahydro-	C ₁₉ H ₃₆	264.497 g/mol		Anticancer, Anti-diabetics, Anticancer
18.	17.414 min	Silicic acid, diethyl bis(trimethylsilyl) ester	C ₁₀ H ₂₈ O ₄ Si ₃	296.585 g/mol		Anti-malarial, Antibacterial Anti-inflammatory
19.	17.499 min	2-Ethylacridine	C ₁₅ H ₁₃ N	207.276 g/mol		Anti protozoal, Anti malarial, Anti bacterial
20.	17.991 min	Ethanone, 2-(2-benzothiazolylthio)-1-(3,5-dimethylpyrazolyl)-	C ₁₄ H ₁₃ N ₃ OS ₂	303.398 g/mol		Anti diuretic, Antiplasmodial, Anti arthritic, Antidiabetic.

GC-MS spectrum of ethanol extract leaf of *A. ficulneus* showed 19 different major peaks which indicated the presence of 19 compounds (Figure 2 & Table 2). The prevailing compounds in ethanol extract were 3-Carene (10.88%), D-Limonene (5.00%), Tetradecane, 2,6,10-trimethyl-(1.69%), Bicyclo[2.2.1] heptan-2-ol, 1,7,7-trimethyl-, formate, endo- (1.69%), Naphthalene (1.11%), Hexadecanoic acid, methyl ester (1.66%), Methyl 9-cis,11-trans-octadecadienoate (8.78%), 13-Octadecenoic acid, methyl ester (4.05%), 9,17-Octadecadienal, (Z)- (16.91%), 2-Methyl-Z,Z-3,13-octadecadienol

(2.66%), 9,17-Octadecadienal, (Z)- (1.90%), 2-Ethylacridine (1.36%), 2-Myristynoyl-glycinamide (3.85%), Benzo [h] quinoline, 2,4-dimethyl- (1.62%), Benzene, 2-[(tert-butyldimethylsilyl)oxy]-1-isopropyl-4-methyl- (15.20%), Cyclobarbital (3.05%), 1,4-Bis (trimethylsilyl) benzene (4.18%), 5-Acetamido-4,7-dioxo-4,7-dihydrobenzofurazan (6.73%) and 1,2-Bis (trimethylsilyl) benzene (0.54%). It has antibacterial activity [9], insecticidal activity [10], antifungal activity [11] and antioxidant Activity [12, 13].

Figure 2: GC-MS Chromatogram of ethanol leaf extracts of *Abelmoschus ficulneus*

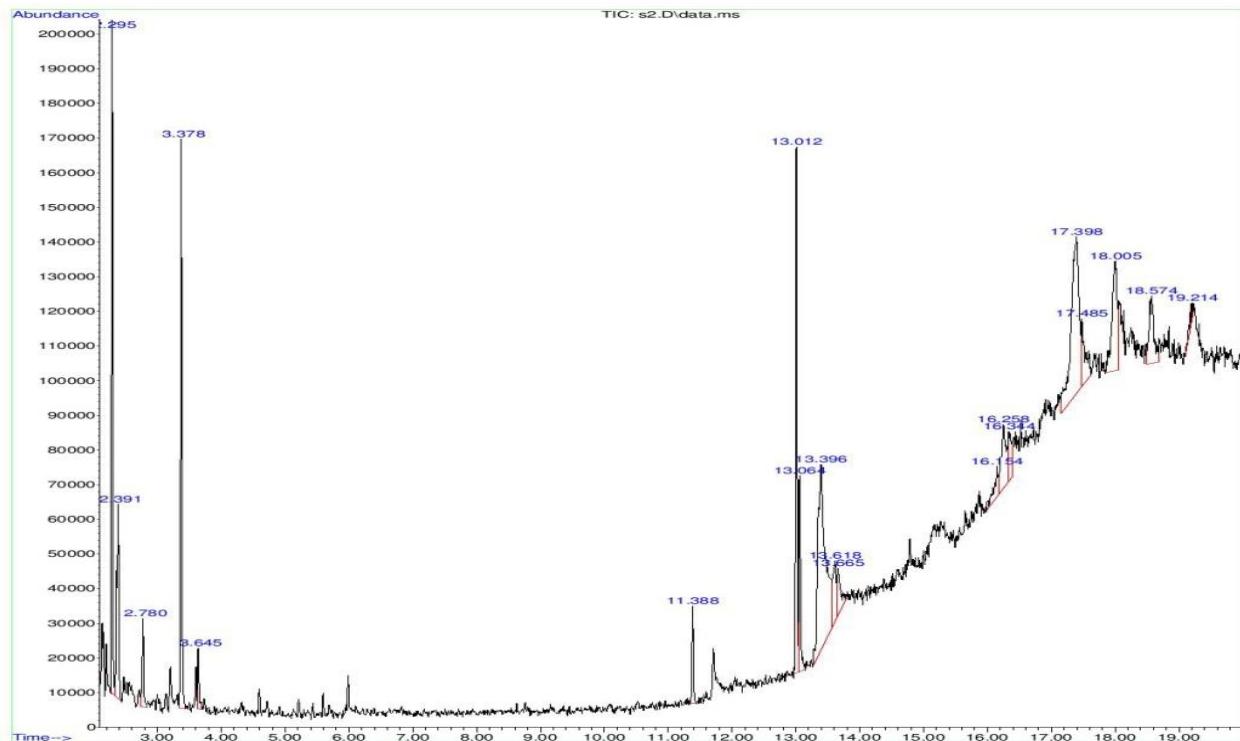
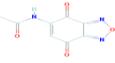


Table 2: GC-MS analysis of ethanol extract of leaf of *Abelmoschus ficulneus*

S. No	Retention time	Name of the compound	Molecular formula	Molecular weight	Structure	Biological activity
1.	2.295 min	3-Carene	C ₁₀ H ₁₆	136.238 g/mol		Antitumor, Antioxidant, Antibacterial, Antifungal.
2.	2.390 min	D-Limonene	C ₁₀ H ₁₆	136.238 g/mol		Antiseptic, Anti-parasitic, Antibacterial, Antiviral
3.	2.777 min	Tetradecane, 2,6,10-trimethyl-	C ₁₇ H ₃₆	240.475 g/mol		Antifungal, Antitumor, Anti-inflammatory

4.	3.382 min	Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, formate, endo-	C ₁₁ H ₁₈ O ₂	182.263 g/mol		Antioxidants, Anti-inflammatory, Analgesic, Antimicrobial
5.	3.647 min	Naphthalene	C ₁₀ H ₈	128.174 g/mol		Anti-inflammatory, Antibacterial, Antiprotozoals, Antineoplastics, Antiviriotics
6.	11.391 min	Hexadecanoic acid, methyl ester	C ₁₇ H ₃₄ O ₂	270.457 g/mol		Hypo-cholesterolemic, Antimicrobial, Antifungal, Antioxidant, Anti-cancer
7.	13.008 min	Methyl 9-cis,11-trans-octadecadienoate	C ₁₉ H ₃₄ O ₂	294.479 g/mol		Antibacterial, Antifungal, Antioxidant, Anti-inflammatory
8.	13.065 min	13-Octadecenoic acid, methyl ester	C ₁₉ H ₃₆ O ₂	296.495 g/mol		Antimicrobial, Antifungal, Antibacterial
9.	13.396 min	9,17-Octadecadienal, (Z)-	C ₁₈ H ₃₂ O	264.453 g/mol		Antibacterial, Antioxidant, Anti-inflammatory
10.	13.622 min	2-Methyl-Z,Z-3,13-octadecadienol	C ₁₉ H ₃₆ O	280.496 g/mol		Anticancer, Antimicrobial, Antioxidant
11.	13.660 min	9,17-Octadecadienal, (Z)-	C ₁₈ H ₃₂ O	264.453 g/mol		Anticancer, Antioxidant, Anti-inflammatory, Antitumor, Antimicrobial, Diuretic
12.	16.156 min	2-Ethylacridine	C ₁₅ H ₁₃ N	207.276 g/mol		Antimicrobial, Antimalarial, Anti-HIV
13.	16.260 min	2-Myristynoyl-glycinamide	C ₁₆ H ₂₈ N ₂ O ₂	280.412 g/mol		Anti protozoal, Anti oxidant, Anti tumor
14.	16.346 min	Benzo[h]quinoline, 2,4-dimethyl-	C ₁₅ H ₁₃ N	207.276 g/mol		Anticonvulsant, Antidiabetic, Antibacterial
15.	17.395 min	Benzene, 2-[(tert-butyldimethylsilyl)oxy]-1-isopropyl-4-methyl-	C ₁₀ H ₁₉ NO	169.268 g/mol		Anti-tumor, Anti-inflammatory, Antibacterial
16.	17.480 min	Cyclobarbital	C ₁₂ H ₁₆ N ₂ O ₃	236.271 g/mol		Antifungal, Antimicrobial, Antimalarial, Anti-HIV

17.	18.010 min	1,4-Bis(trimethylsilyl)benzene	C ₁₂ H ₂₂ Si ₂	222.478 g/mol		Antibacterial, Antioxidants, Anti fungal
18.	18.577 min	5-Acetamido-4,7-dioxo-4,7-dihydrobenzofuran	C ₈ H ₅ N ₃ O ₄	207.145 g/mol		Anti-inflammatory, Anti-diuretic, Anticancer, Antioxidant
19.	19.211 min	1,2-Bis(trimethylsilyl)benzene	C ₁₂ H ₂₂ Si ₂	222.478 g/mol		Anti-inflammatory Anti tumor Anti hyperlipidemic

GC-MS spectrum of ethanol extract root of *A. ficulneus* showed 30 different major peaks which indicated the presence of 30 compounds (Figure 3 & Table 3). The prevailing compounds in ethanol extract were 3-Carene (2.83%), D-Limonene (1.38%), Octadecane, 1-chloro- (0.58%), 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl- (0.56%), Isoborneol (19.82%), Naphthalene (0.30%), Cyclohexene, 1-methyl-4-(1-methylethylidene)- (0.70%), Alloaromadendrene (0.64%), Ar-tumerone (0.86%), Cyclohexane, (2-bromoethyl)- (0.42%), Benzene, 1,1'- [oxybis (methylene)] bis [4-ethyl- (0.42%), Dodecanoic acid, methyl ester (0.37%), n-Hexadecanoic acid (11.07%), Hexadecanoic acid,

ethyl ester (1.42%), Preg-4-en-3-one, 17.alpha.-hydroxy-17.beta.-cyano- (0.76%), 9,12-Octadecadienoic acid, methyl ester, (E,E) (1.85%), trans-13-Octadecenoic acid, methyl ester (0.77%), 9,12-Octadecadienoic acid (Z,Z)- (18.01%), cis-13-Octadecenoic acid (24.20%), 9,12-Octadecadienoic acid (Z,Z)- (4.62%), 9,17-Octadecadienal, (Z)-(1.95%), 2-Methyl-7-phenylindole (0.24%), N-Methyl-1-adamantaneacetamide (0.55%), 2-Ethylacridine (0.23%), Tris (tert-butyldimethylsilyloxy) arsane (0.47%), Cyclotrisiloxane, hexamethyl- (1.06%), 1,2-Bis(trimethylsilyl) benzene (0.23%), Cyclobarbital (0.93%), 1,2-Bis(trimethylsilyl) benzene (0.59%) and 1,4-Bis(trimethylsilyl) benzene (2.19%).

Figure 3: GC-MS Chromatogram of ethanol root extracts of *Abelmoschus ficulneus*

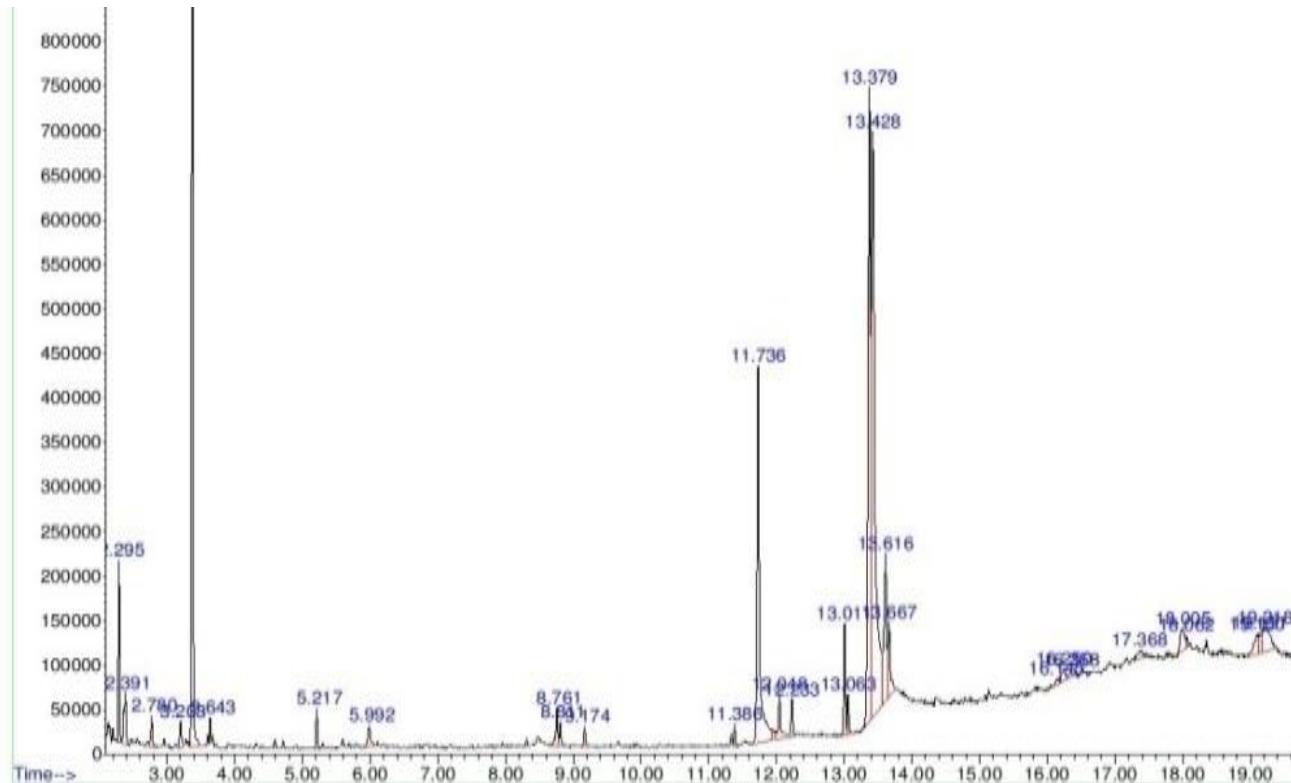


Table 3: GC-MS analysis of ethanol extract of root of *Abelmoschus ficulneus*

S. No	Retention time	Name of the compound	Molecular formula	Molecular weight	Structure	Biological activity
1.	2.295 min	3-Carene	C ₁₀ H ₁₆	136.238 g/mol		Antitumor, Antioxidant, Antibacterial, Antifungal
2.	2.389 min	D-Limonene	C ₁₀ H ₁₆	136.238 g/mol		Antiseptic, Anti-parasitic, Antibacterial, Antiviral
3.	2.777 min	Octadecane, 1-chloro-	C ₁₈ H ₃₇ Cl	288.944 g/mol		Antibacterial, Antioxidant, Anti Inflammatory
4.	3.203 min	4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-methyl-	C ₆ H ₈ O ₄	144.126 g/mol		Antimicrobial, Anti Inflammatory, Anti proliferative
5.	3.382 min	Isoborneol	C ₁₀ H ₁₈ O	154.253 g/mol		Antimicrobial, Antibacterial, Anti-inflammatory
6.	3.647 min	Naphthalene	C ₁₀ H ₈	128.174 g/mol		Anti-Inflammatory activities, Anti-bacterial, Antiprotozoals, Anti-neoplastics, Anti-virotics,
7.	5.217 min	Cyclohexene, 1-methyl-4-(1-methylethylidene)-	C ₁₀ H ₁₆	136.238 g/mol		Antifungal, antimicrobial and antioxidant
8.	5.992 min	Alloaromadendrene	C ₁₅ H ₂₄	204.357 g/mol		Antibacterial Anti-inflammatory, Anticancer, Anti-amoebic
9.	8.762 min	Ar-tumerone	C ₁₅ H ₂₀ O	216.324 g/mol		Antimicrobial, Antibacterial Antifungal
10.	8.810 min	Cyclohexane, (2-bromoethyl)-	C ₈ H ₁₅ Br	191.112 g/mol		Anti bacterial, Antifungal
11.	9.178 min	Benzene, 1,1'-[oxybis(methylene)]bis[4-ethyl-	C ₁₈ H ₂₂ O	254.373 g/mol		Antibacterial, Antiprotozoal, Anti oxidant
12.	11.391 min	Dodecanoic acid, methyl ester	C ₁₃ H ₂₆ O ₂	214.349 g/mol		Anti-inflammatories Analgesics, Anti bacterial
13.	11.731 min	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256.43 g/mol		Antimicrobial activities, Anti-Inflammatory
14.	12.053 min	Hexadecanoic acid, ethyl ester	C ₁₈ H ₃₆ O ₂	284.484 g/mol		Anti-inflammatory, Anesthetic, Antiviral Antineurotic
15.	12.232 min	Preg-4-en-3-one, 17.alpha.-hydroxy-17.beta.-	C ₁₉ H ₂₈ O ₂	288.431 g/mol		Antibacterial, Anticancer

		cyano-				
16.	13.008 min	9,12-Octadecadienoic acid, methyl ester, (E,E)-	C ₁₉ H ₃₄ O ₂	294.479 g/mol		Antimicrobial, Anti-cancer, Anti-inflammatory, Antiandrogenic
17.	13.064 min	trans-13-Octadecenoic acid, methyl ester	C ₁₉ H ₃₆ O ₂	296.495 g/mol		Antimicrobial, inflammatory, cholesterolemic
18.	13.376 min	9,12-Octadecadienoic acid (Z,Z)-	C ₁₈ H ₃₂ O ₂	280.452 g/mol		Antibacterial, Anti-inflammatory, Antioxidant
19.	13.424 min	cis-13-Octadecenoic acid	C ₁₈ H ₃₄ O ₂	282.468 g/mol		Hypocholesterolemic, Antibacterial, Antifungal
20.	13.613 min	9,12-Octadecadienoic acid (Z,Z)-	C ₁₈ H ₃₂ O ₂	280.452 g/mol		Antibacterial, Anti-inflammatory, Antioxidant
21.	13.670 min	9,17-Octadecadienal, (Z)-	C ₁₈ H ₃₂ O	264.453 g/mol		Antibacterial, Antioxidant, Anti-inflammatory
22.	16.147 min	2-Methyl-7-phenylindole	C ₁₅ H ₁₃ N	207.276 g/mol		Anti-inflammatory, Antioxidant, Antifungal
23.	16.251 min	N-Methyl-1-adamantaneacetamide	C ₁₃ H ₂₁ NO	207.317 g/mol		Antibacterial, Antifungal, Anti oxidant
24.	16.355 min	2-Ethylacridine	C ₁₅ H ₁₃ N	207.276 g/mol		Anti protozoal, Anti malarial, Anti bacterial.
25.	17.367 min	Tris(tert-butylidemethylsilyloxy)arsane	C ₁₈ H ₄₅ AsO ₃ Si ₃	468.732 g/mol		Antimicrobial activity, Antioxidant, Anti bacterial
26.	18.010 min	Cyclotrisiloxae, hexamethyl-	C ₆ H ₁₈ O ₃ Si ₃	222.462 g/mol		Antimicrobial, Antioxidant
27.	18.066 min	1,2-Bis(trimethylsilyl)benzene	C ₁₂ H ₂₂ Si ₂	222.478 g/mol		Anti Inflammatory, Anti tumor, Anti hyperlipidemic
28.	19.097 min	Cyclobarbital	C ₁₂ H ₁₆ N ₂ O ₃	236.271 g/mol		Antifungal, Antimicrobial, Antimalarial, Anti-HIV
29.	19.154 min	1,2-Bis(trimethylsilyl)benzene	C ₁₂ H ₂₂ Si ₂	222.478 g/mol		Anti-inflammatory, Anti tumor, Anti hyperlipidemic
30.	19.220 min	1,4-Bis(trimethylsilyl)benzene	C ₁₂ H ₂₂ Si ₂	222.478 g/mol		Anti-inflammatory, Antihyperlipidemic

GC-MS spectrum of ethanolic fruit extract of *A. fulcneus* showed 12 different major peaks which indicated the presence of 12 compounds (Figure 4 & Table 4). The prevailing compounds in ethanol extract were 3-Carene (19.40%), D-Limonene (9.14%), 1-Octadecanesulphonyl chloride

(3.03%), Isoborneol (20.71%), Naphthalene (2.09%), n-Hexadecanoic acid (7.19%), Ethanol, 2-(9,12-octadecadienyoxy)-, (Z,Z)- (3.76%), 9,12-Octadecadienoic acid (Z,Z)- (5.64%), 9,12-Octadecadienoic acid (Z,Z)- (23.30%), 9-Methylbicyclo[3.3.1]nonane (2.65%), (5-Isopropyl-2-

methylphenoxy) tri-methylsilane (2.08%), 1,2-Benzisothiazol-3-amine and tbdms (1.01%). Among the identified phytochemicals hexadecanoic acid is suggested to be a fatty acid ester and it may

employed as antioxidant, antimicrobial, flavor, hypocholesterolemic agent and larvicidal activities [14, 15].

Figure 4: GC-MS Chromatogram of ethanol fruit extracts of *Abelmoschus ficulneus*

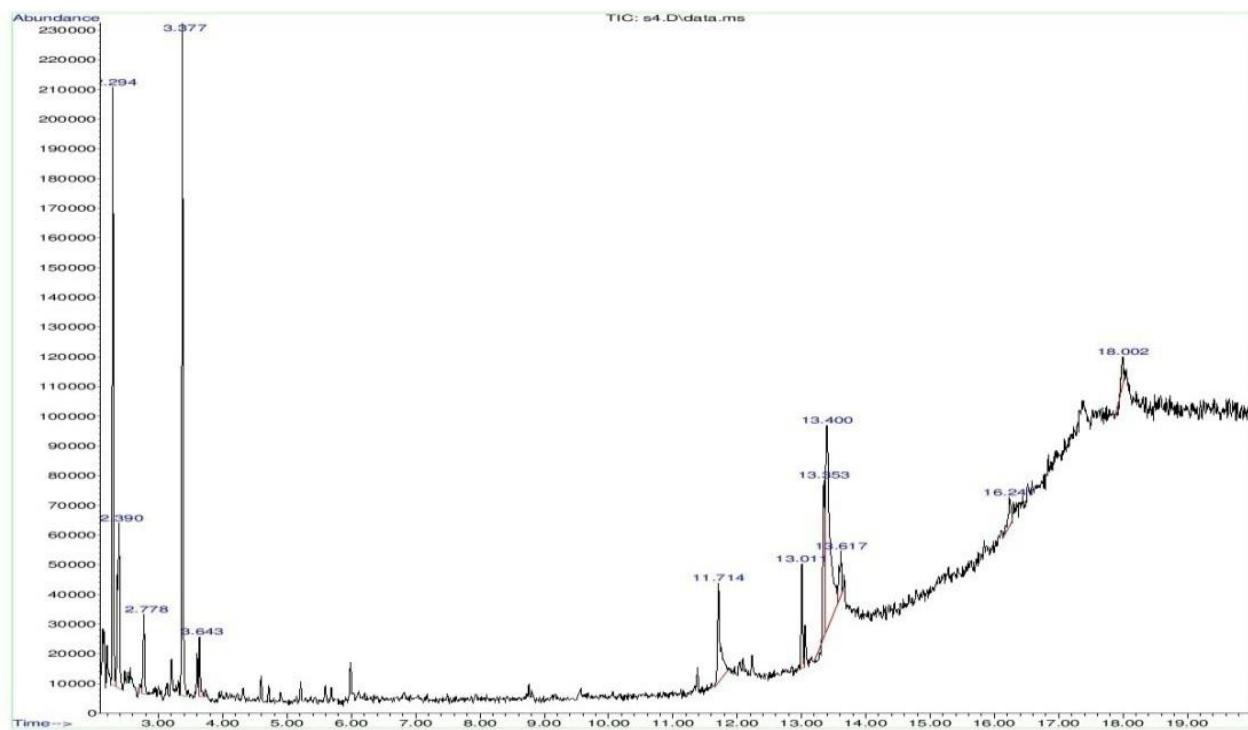


Table 4: GC-MS analysis of ethanol extract of fruit of *Abelmoschus ficulneus*

S. No	Retention time	Name of the compound	Molecular formula	Molecular weight	Structure	Biological activity
1.	2.295 min	3-Carene	C ₁₀ H ₁₆	136.238 g/mol		Anti-inflammatory, Analgesic, Antiseptic, Antibacterial, Antipyretic
2.	2.389 min	D-Limonene	C ₁₀ H ₁₆	136.238 g/mol		Antiseptic,Anti-parasitic, Antibacterial, Antiviral
3.	2.777 min	1-Octadecanesulphonyl chloride	C ₁₈ H ₃₇ ClO ₂ S	353.002 g/mol		Antioxidant, Anti-inflammation
4.	3.373 min	Isoborneol	C ₁₀ H ₁₈ O	154.253 g/mol		Antiviral Activity, Antibacterial and Antifungal activity
5.	3.647 min	Naphthalene	C ₁₀ H ₈	128.174 g/mol		Anti-inflammatory activities, Antibacterial, Antiprotozoals, Antineoplastics, Antiviriotics
6.	11.712 min	n-Hexadecanoic acid	C ₁₆ H ₃₂ O ₂	256.43 g/mol		Antimicrobial activities, Anti-inflammatory

7.	13.008 min	Ethanol, 2-(9,12-octadecadienoxy)-(Z,Z)-	C ₂₀ H ₃₈ O ₂	310.522 g/mol		Anticancer, Anti-inflammatory, Antimicrobial
8.	13.348 min	9,12-Octadecadienoic acid (Z,Z)-	C ₁₈ H ₃₂ O ₂	280.452 g/mol		Antibacterial, Anti-inflammatory, Antioxidant
9.	13.405 min	9,12-Octadecadienoic acid (Z,Z)-	C ₁₈ H ₃₂ O ₂	280.452 g/mol		Antibacterial, Anti-inflammatory, Antioxidant
10.	13.613 min	9-Methylbicyclo[3.3.1]nonane	C ₁₀ H ₁₈	138.254 g/mol		Antibacterial, Antifungal, Antitumor
11.	16.241 min	(5-Isopropyl-2-methylphenoxy)trimethylsilane	C ₁₂ H ₁₆ O ₃	208.257 g/mol		Anti-inflammatory, Antifungus, Antimicrobial, Anticancer
12.	18.000 min	1,2-Benzisothiazol-3-amine tbdms	C ₁₃ H ₂₀ N ₂ SSi	264.462 g/mol		Antioxidants, Antimutagenic, Anticarcinogenic

GC-MS analysis of chloroform extracts in flowers, stems and roots of *Tripleurospermum callosum* revealed the identification of 93 compounds [16]. D-Limonene is a bioactive food component commonly found in the peel of citrus. It comprises 90–95% orange peel oil and 75% of lemon peel oil [17]. d-Limonene has demonstrated strong chemo preventive effects in rodent lymphomas [18] and mammary [19], gastric [20], skin, liver, and lung cancers [21]. In humans, consumption of citrus peels has been shown to be significantly related to lower incidence of squamous cell carcinoma, suggesting a protective effect [22].

Conclusion

In the present study was concluded so many compounds from different parts of the ethanol extracts of *A. ficalneus* were identified by Gas-chromatography– Mass spectrometry (GC-MS) analysis. The biological activities of each identified components were used for antimicrobial, antioxidant, anti-tumor and anti-cancer activities. Chemical identification of the plant constituents was conducted based on their retention time (RT), molecular formula, molecular weight and mass spectral data, as well as by computer search mass spectral databases. The chemical structures and medicinal properties also identified. The results revealed the presence of medicinally significant constituents in the plants studied. Therefore, ethanol extracts from these plants could be seen as a good source for using drugs.

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