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GAS CHROMATOGRAPHY-MASS SPECTROMETRIC ANALYSIS OF ACETONE EXTRACT OF *CENCHRUS CILIARIS* (DHAMAN GRASS)

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ABSTRACT
The investigation was carried out to determine the possible bioactive components of acetone extracts of *Cenchrus ciliaris* using Gas chromatography-Mass spectrometry (GC-MS). All the samples were dried firstly at 60°C for 2 days in an oven after that leave it on room temperature. They were then macerated to powder form with a mixer grinder. The powder was stored in air sealed polythene bags at room temperature before extraction. The chemical compositions of the acetone extract of *C. ciliaris* were investigated using 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 the extract reveals the identification of seventy four compounds. This is the first report of identification of components from the whole plant of *C. ciliaris* by GC-MS. Most of the compounds in the list are bioactive and possess medicinal properties.

KEY WORDS: *Cenchrus ciliaris*, Gas chromatography-Mass spectrometry, bioactive components.

INTRODUCTION

Taking into consideration of the medicinal importance of this plant, the acetone extract of the whole plant of *Cenchrus ciliaris* were analyzed for the first time using Gas chromatography-Mass spectrometry (GC-MS). This work will help to identify the compounds of therapeutic value. GC-MS is one of the best techniques to identify the bioactive constituents of long chain, branched chain hydrocarbons, alcohols, acids, ester, steroids, phenolic compounds *etc*. (Amakrishnan, 2011). Medicinal plants are used in traditional treatments to cure variety of diseases. In the last few decades there has been an exponential growth in the field of herbal medicine. Natural products have been a source of drugs for centuries. In the present study acetone extract of *C. ciliaris* were analyzed by GC-MS technique to study the major and minor phyto-constituents of the vegetative parts of the whole plant. *Cenchrus ciliaris* is known as Dhaman grass. It is extremely variable species tufted (sometimes shortly rhizomatous) perennial, with types ranging in habit from ascendant to erect, and branching culms from about 0.3-2.0 m at maturity. Leaf blades linear, 2-13 mm wide and 3-30 cm long; green, blue green to grey green in colour, scabrous, mostly glabrous, sometimes hairy at the base. Panicle an erect or nodding, straw, grey or purple coloured, bristly, false spike, 2-15 cm long and 1-2.5 cm wide, with seed units or fascicles inserted along a zig-zag axis. Each bur-like fascicle comprises a single spikelet or cluster of 2-4 spikelets, 3.5-5 mm long surrounded by an involucres of bristles of various length up to 16 mm long; bristles barbed and hairy, giving the fascicle an adhesive quality. This grass is gaining attention in various field of research, as they are best suited to the present environmental conditions (Singariya *et al*., 2012a). This is more competitive under the conditions of high temperature, solar radiation and low moisture (Singariya *et al*., 2012u) and is more efficient at gathering CO_2 and utilizing nitrogen from the atmosphere and recycled N in the soil (Bessman, 1956; Singariya, 2009). This grass has excellent soil binding capacity which helps to conserve soil in desert areas (Sinha *et al*., 1996). This grass, fed green, turned into silage, or made into hay is said to increase flow of milk in cattle and impart a sleek and glossy appearance (Singariya *et al*., 2012v). Seeds of this grass are used as famine food by the tribal during severe conditions (Katewa and Sharma, 2004). However, *C. ciliaris* is most suitable and highly nutritive grasses for desert environmental conditions (Singariya *et al*., 2012b).

MATERIALS & METHODS

Plant material

Cenchrus ciliaris (RUBL-14118) were collected in the month of August 2009 from the Central Arid Zone Research Institute (CAZRI), Jodhpur (Rajasthan). Plants samples were identified and deposited in the herbarium, Department of Botany, University of Rajasthan, Jaipur. The collected plant materials were transferred immediately to the laboratory cleaned with water and selected plant parts were separately shade dried (Singariya *et al*., 2012l) until weight has been constant.

Preparation of plant extracts

The collected plant materials were shade dried, powered with the help of grinder (Singariya *et al*., 2012m) and passed

through 40mm meshes and stored in clean container for further use (Singariya *et al*., 2012o). The dried powder material was extracted with acetone by using the Soxhlet apparatus (Subramanian and Nagarajan, 1969) for 18 hours at a temperature not exceeding the boiling point of the respective solvent (Singariya *et al*., 2013; Singariya *et al*., 2012k). The obtained extracts were filtered by using Whatman No. 1 filter paper and then concentrated at 40^0C by using an evaporator (Singariya *et al*., 2012p) and stored the residual extracts in refrigerator at 4^0C in small and sterile amber colour glass bottles (Singariya *et al*., 2012n) for subsequent use in the further antimicrobial, anti-fungal and phyto-chemical analysis. The extract contains both polar and non-polar phyto-components.

Gas chromatography-Mass spectrometry analysis

Gas chromatography-Mass spectrometry (GC-MS) analysis of these extracts was carried out by following the method of Hema *et al*., 2010. The GC-MS analysis of the extracts was performed using a GC-MS (Model; QP 2010 series, Shimadzu, Tokyo, Japan) equipped with a VF-5ms fused silica capillary column of 60m length, 0.25mm dia., and 0.25mm film thickness (Singariya *et al*., 2014). Injection Mode: Split, Flow Control Mode: Linear Velocity, Pressure: 173.3 kPa, Linear Velocity: 28.9cm/sec, Purge Flow: 3.0 mL/min, Split Ratio: 10.0. For GC-MS detection [GC-2010], an electron ionization system with ionization energy of 70eV was used. Helieum gas (99.99%) was used as a carrier gas at a constant flow rate- total flow: 16.3 mL/min. and column flow: 1.21 mL/min. injector and mass transfer line temperature were set at 200 and 240°C respectively. The oven temperature was programmed (Column Oven Temp.: 100.0°C and Injection Temp.: 270.00°C) from 70to 220°C at 10°C/min, held isothermal for 1min and finally raised to 300°C AT 10°C/min. 2ml of respective diluted samples was manually injected in the split less mode, with split ratio of 1:40 and with mass scan of 50-600 amu. Total running time of GC-MS is 48 minutes. The relative % amount of each component was calculated by comparing its average peak area to the total areas, software adopted to handle mass spectra and chromatograms was a Turbomass. The relative percentage of the each extract constituents was expressed as percentage with peak area normalization.

Identification of Components

Interpretation on mass spectrum of GC-MS was done using the database of National Institute of standard and Technology NIST-08 LIB. (Mc-Lafferly,1989) and WILEY-8 LIB. (Stein, 1990) library sources were used for matching the identified components from the plant material having more than 62,000 patterns. The mass spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The name, molecular weight and structure of the components of the test materials were ascertained (Singariya *et al*., 2012w).

RESULTS

Fatty acid ethyl asters perturb the cell cycle and induce apoptosis in the cancer cells (Aydin *et al*., 2005). They are also used as markers of excessive alcohol consumption (Hartwig *et al*., 2003). Hexadecenal is a prevalent component found in many medicinal plants (Nazlina *et al*., 2011). Alpha-tocopherol has potent anti-onti-oxidant properties. A reduction of 34% is observed in the incidence of prostate cancer in smokers given daily supplements of 50 mg of alpha-tocopherol. Other analysis also suggests the association of alpha-tocopherol supplement use with a 15% lower risk of prostate cancer (Heinonen *et al*., 1998). Numerous studies have also reported the beneficial effects of the dietary intake of phytosterols. Ergost-5-en-3 beta-ol, also called "campesterol" competes with cholesterol and thus reduces the absorption of cholesterol in the human intestine (Heggen *et al*., 2010; Choudhary and Tran, 2011). Phytosterols indirectly (*in-vivo* as a dietary supplement) and directly (in tissue culture media) inhibit the growth and metastasis of prostate cancer PC-3 cells (Awad *et al*., 2001). In most of the parameters, beta-Sitosterol seems to be more effective than campesterol in offering this protection. Stigmasterol is used as the precursor of vitamin D_3 (Kametani and Furuyama, 1987) and in the manufacture of synthetic progesterone, a valuable human hormone that plays an important physiological role in the regulatory and tissue building mechanisms related to estrogen effects, as well as acting as an intermediate in the biosynthesis of androgens, estrogens and corticoids (Sundararaman and Djerassi, 1977). The active principles with their retention time (RT), molecular formula (MF), molecular weight (MW) and concentration (%) in the acetone extracts of the whole plant of *C. ciliaris* are presented in tables 1 and 2 followed by (Singariya *et al*., 2012q). The GC-MS analysis of the extracts showed the presence of phyto-components, the phyto-components of the above said plant extract are presented in Table-1 & 2 and the GC-MS chromatogram with peak area of each extract is also given figure-1. Totally 74 bio-active constituents were identified in the present study from the acetone extracts of the whole plant of *C. ciliaris* which including both major and minor constituents. The major constituents were stigmasterol (10.36 %) (fig-2); 4,22-stigmastadiene-3-one (6.80 %) (fig-3); heptacosane (6.06 %); stigmast-4-en-3-one (5.86 %) (fig-4); β-sitosterol (5.39 %) (fig-5) and along with major constituents, minor constituents were 1-iodoundecane (0.08 %); pentane, 2,2,3,4-tetramethyl- (0.09 %); decanoic acid, propyl ester (0.11 %); tetracosane (0.15 %); 2-piperidinone, N-[4-bromo-n-butyl]- (0.15 %); ethyl iso-allocholate (0.49 %) and Cholest-4-en-3-one (1.67 %) also reported. Some important hits showing in table-2. In previous investigation Cholest-4-en-3-one (2.36 %) was reported in acetone extract of *C. setigerus* (Singariya *et al*., 2012r). Ethyl iso-allocholate has antimicrobial, Diuretic and anti-inflammatory activity (Singariya *et al*., 2012t). 4,22-stigmastadiene-3-one (2.41%) were found in the ethyl acetate extract of *C. ciliaris* (Singariya *et al*., 2012s). The GC-MS chromatogram with peak area has shown in fig-1. The aim of the present study is to provide more information about the essential phyto-constituents of *C. ciliaris*. The results from the present investigation were very encouraging and indicates that this plant should be studied more

Sample Information

Analyzed by	: $Ajai Kumar$
Analyzed	: 3/30/2012 3:49:32 PM
Sample Type	: $Extract$
Sample Name	: A-1
Method File	: D:\GCMS Method\Outsiders\Rajesthan Uni\Premlata.q gm

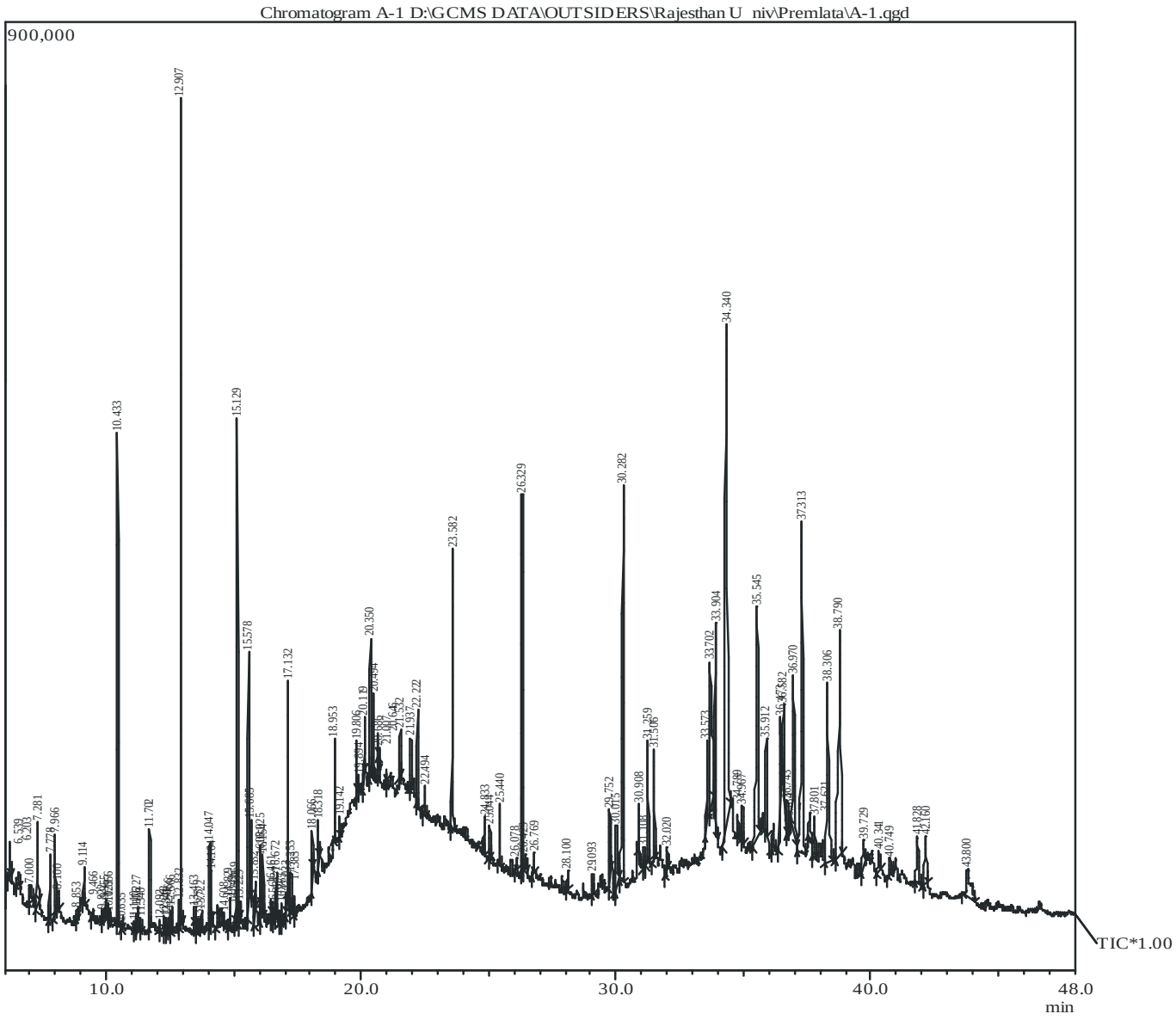


FIGURE 1: Chromatogram of acetone extract of *Cenchrus ciliaris* by GC-MS

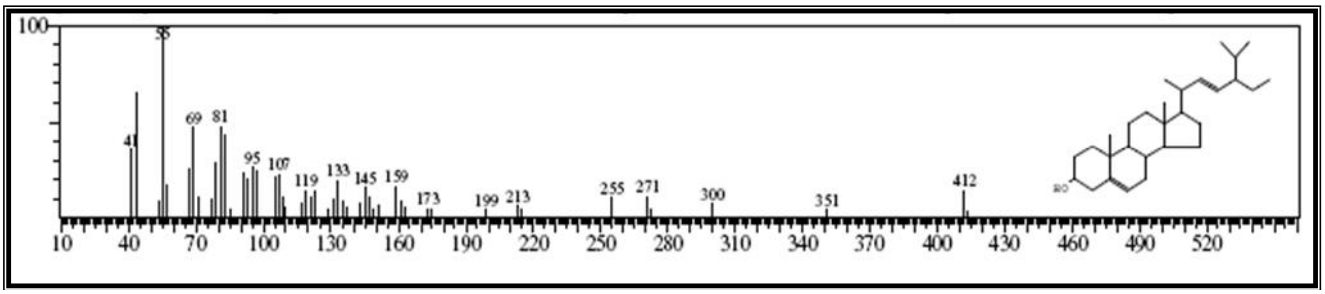


FIGURE 2: (Stigmasterol)

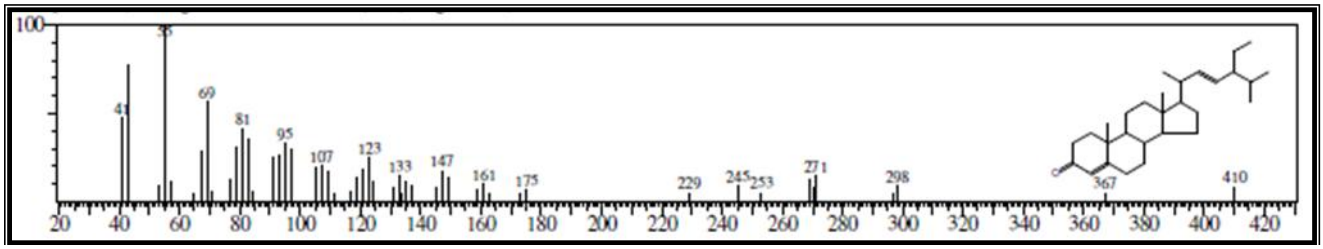


FIGURE 3: (4,22-Stigmastadiene-3-one)

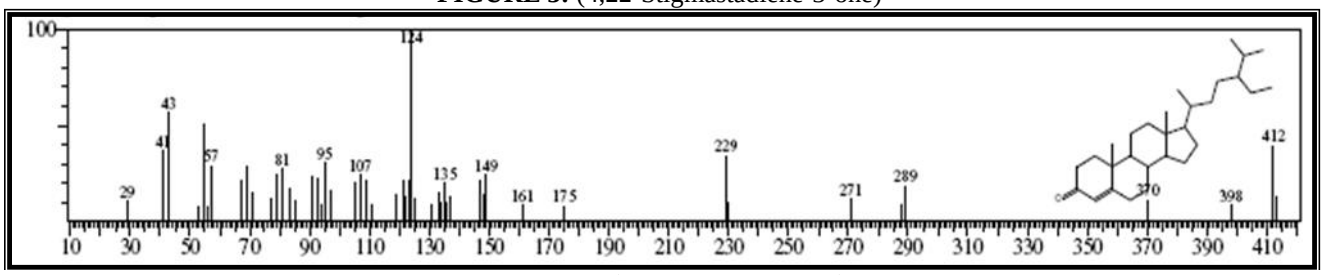


FIGURE 4: (Stigmast-4-en-3-one)

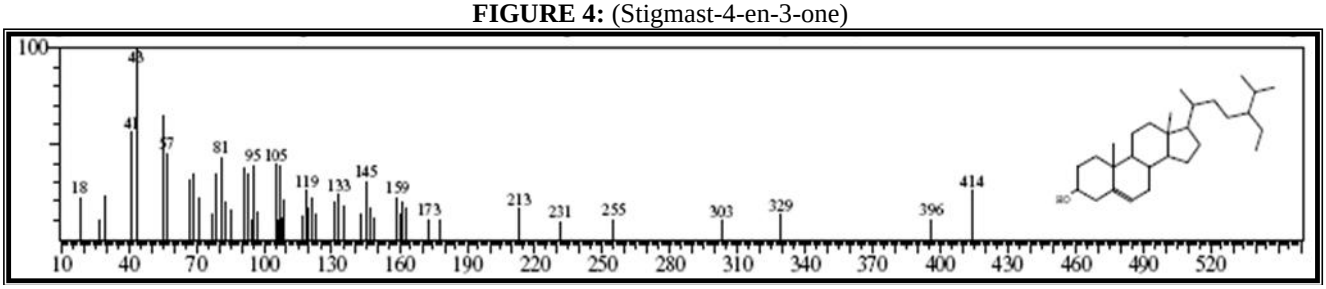


FIGURE 5: (β-sitosterol)

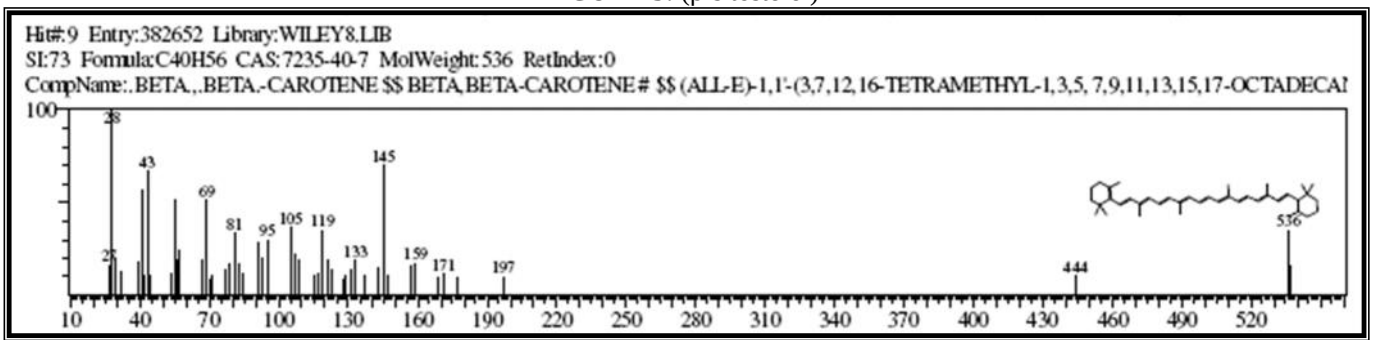
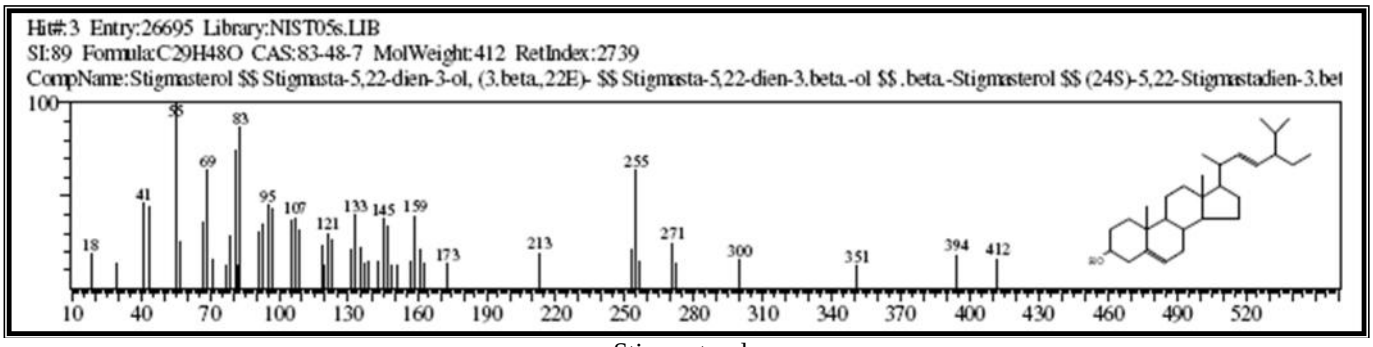
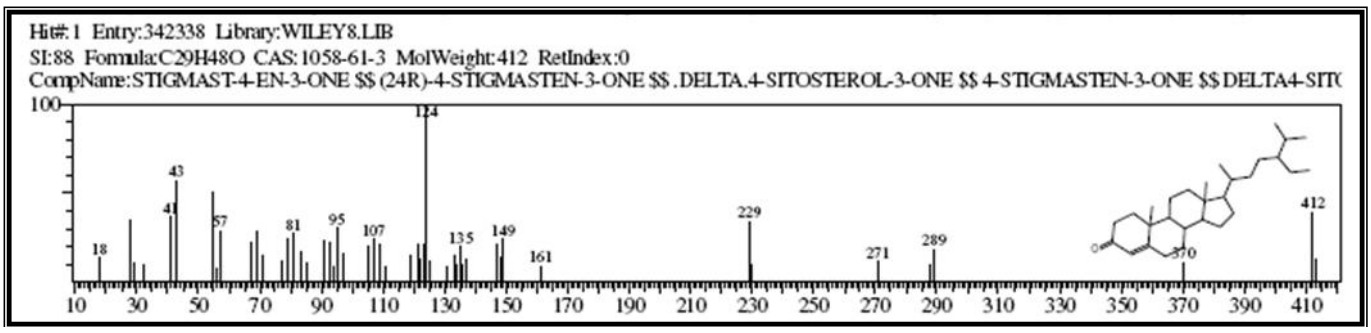


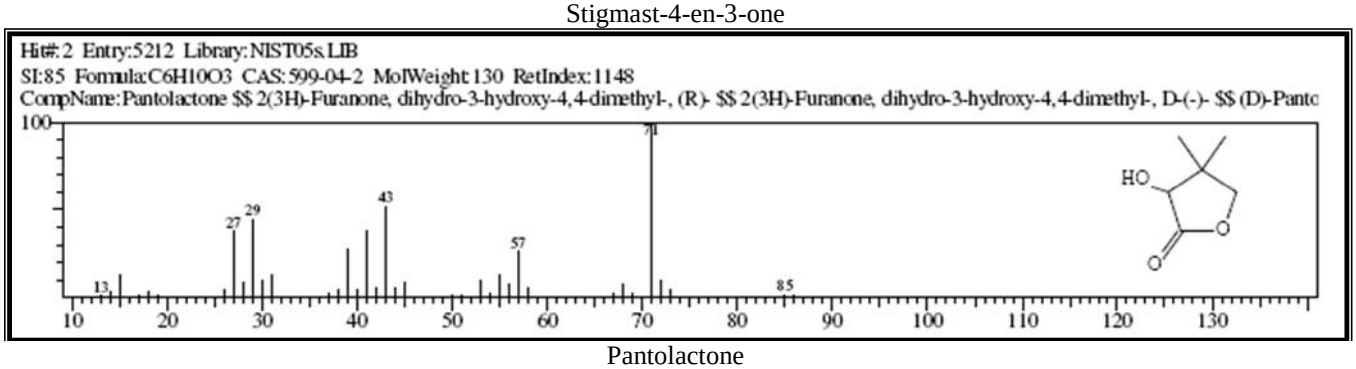
FIGURE 3: The best hits for the prevailing compounds in the chromatogram
Beta., Beta.- Carotene



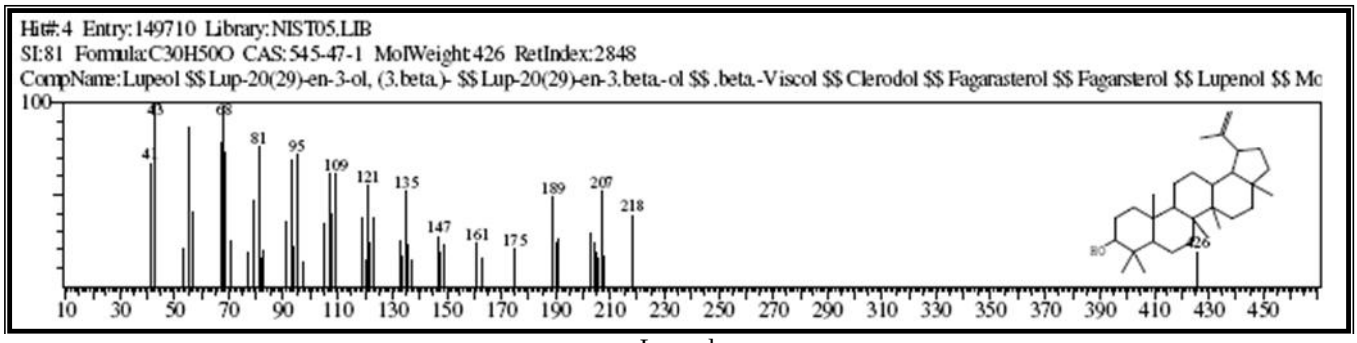
Stigmasterol



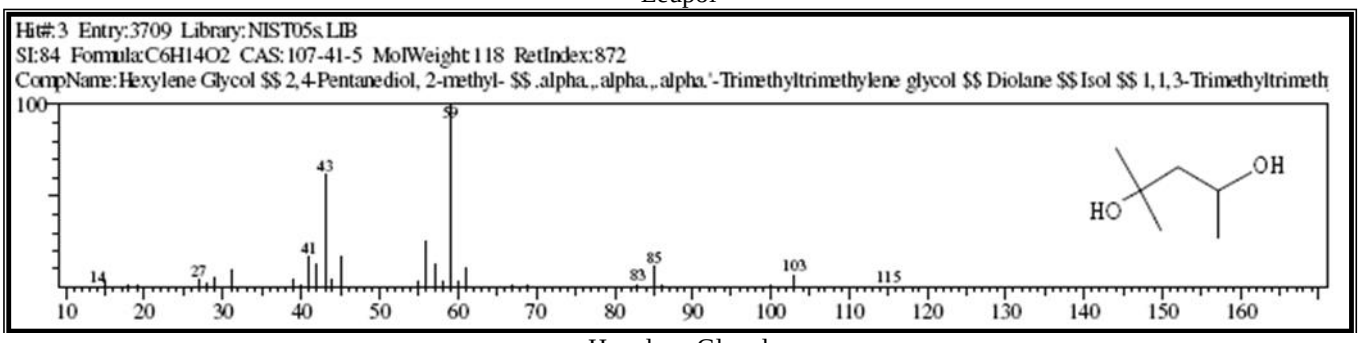
Stigmast-4-en-3-one



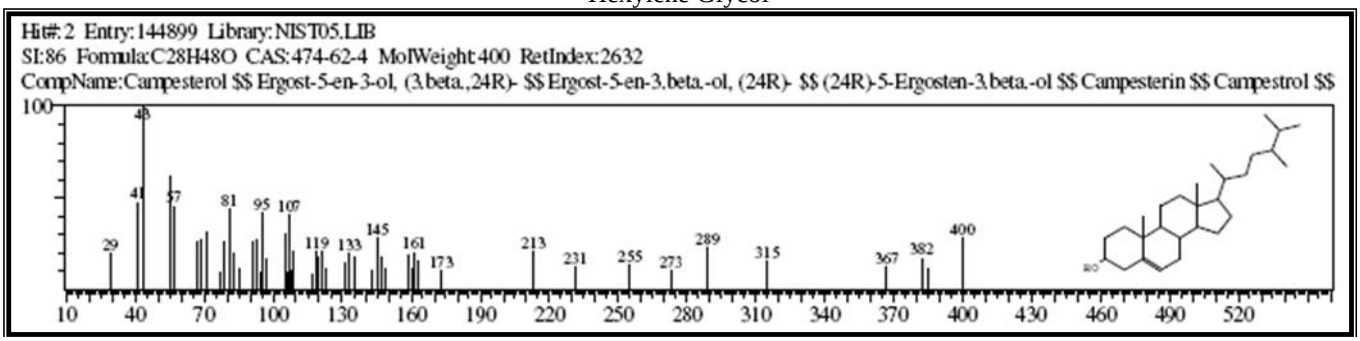
Pantolactone



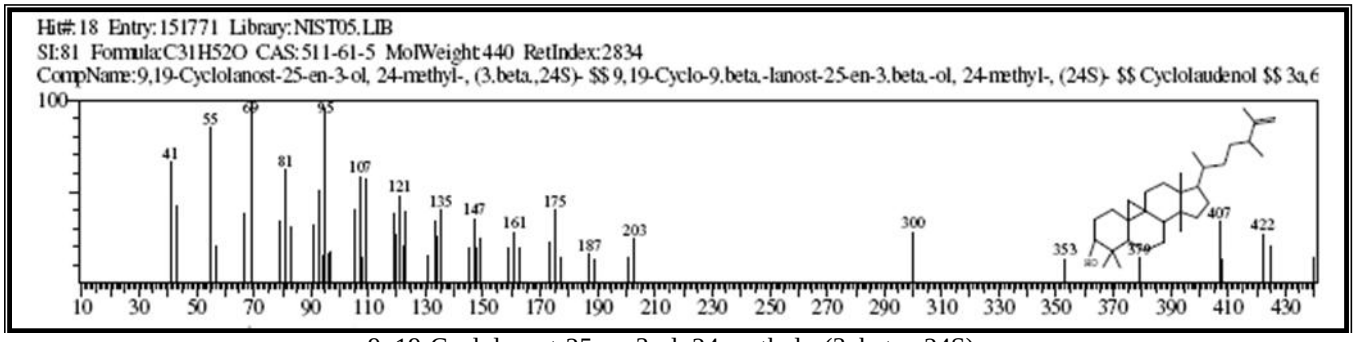
Leupol



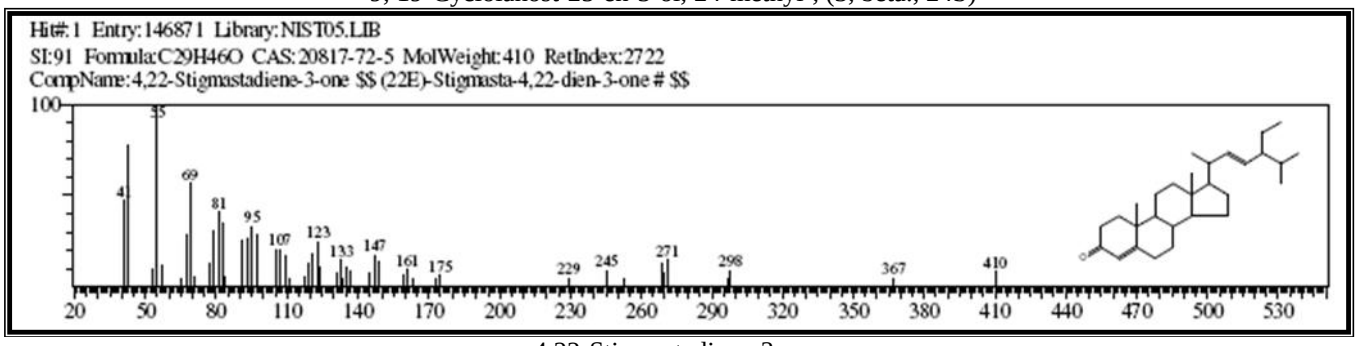
Hexylene Glycol



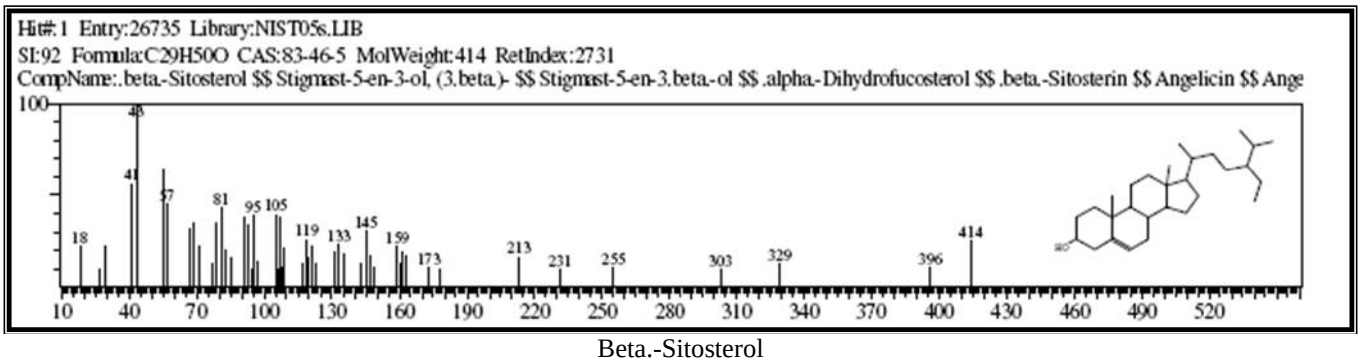
Campesterol



9, 19-Cyclolanost-25-en-3-ol, 24-methyl-, (3, beta., 24S)-



4,22-Stigmastadiene-3-one



Beta.-Sitosterol

TABLE1: Compounds identified in the acetone extract of *Cenchrus ciliaris*

P	R. T.	Area	Area (%)	Compound name	M. F.	M. W.
1	6.203	115880	0.47	Pantolactone	$C_6H_{10}O_3$	130
2	7.281	268317	1.09	2,6-Dimethyl-6-nitro-2-hepten-4-one	$C_9H_{15}NO_3$	185
3	7.778	143995	0.59	Octane, 3,4,5,6-tetramethyl-	$C_{12}H_{26}$	170
4	7.966	255275	1.04	Hexylene Glycol	$C_6H_{12}O_2$	118
5	9.114	75113	0.31	Butane, 2,2-dimethyl-	C_6H_{14}	86
6	10.433	837085	3.42	Tridecane	$C_{13}H_{28}$	184
7	11.702	173020	0.71	Hexadecane	$C_{16}H_{34}$	226
8	12.566	39861	0.16	Butane, 2,2,3-trimethyl-	C_7H_{16}	100
9	12.832	38889	0.16	3-Tetradecene, (Z)-	$C_{14}H_{28}$	196
10	12.907	1270349	5.18	Heptadecane	$C_{17}H_{36}$	240
11	13.463	21211	0.09	Pentane, 2,2,3,4-tetramethyl-	C_9H_{20}	128
12	14.047	132673	0.54	Oxalic acid, isobutyl pentyl ester	$C_{11}H_{20}O_4$	216
13	14.104	78965	0.32	Dodecane. 2.6.11-trimethyl-	$C_{15}H_{32}$	212
14	14.829	49896	0.20	1-Iodo-2-methylundecane	$C_{12}H_{25}I$	296
15	15.578	472098	1.93	Oxirane, tetradecyl-	$C_{16}H_{32}O$	240
16	15.685	117726	0.48	2-Pentadecanone, 6,10,14-trimethyl-	$C_{18}H_{36}O$	268
17	15.832	56382	0.23	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296
18	16.025	111280	0.45	1-Octadecyne	$C_{18}H_{34}$	250
19	16.081	70438	0.29	Phthalic acid, butyl undecyl ester	$C_{23}H_{36}O_4$	376
20	16.154	80291	0.33	Decane. 2.3.5.8-tetramethyl-	$C_{14}H_{30}$	198
21	16.672	74035	0.30	Naphthalene, 1,2,3,4,4a,5,6,8a-octahydro- 4a,8-dimethyl-2-(1-methylethenyl)-, [2R- (2α, 4aα, 8aβ)]-	$C_{15}H_{24}$	204
22	16.865	20510	0.08	1-Iodoundecane	$C_{11}H_{23}I$	282
23	17.132	336981	1.38	Eicosane	$C_{20}H_{42}$	282

24	17.253	70267	0.29	Hexadecanoic acid, 2-oxo-, methyl ester	$C_{17}H_{32}O_3$	284
25	17.383	27752	0.11	Decanoic acid, propyl ester	$C_{13}H_{26}O_2$	214
26	18.066	79046	0.32	2-Bromo dodecane	$C_{12}H_{25}Br$	248
27	18.318	74035	0.30	Phytol	$C_{20}H_{40}O$	296
28	18.953	171530	0.70	Pentadecane, 8-heptyl-	$C_{22}H_{46}$	310
29	19.806	82757	0.34	Octacosane	$C_{28}H_{58}$	394
30	20.119	147145	0.60	Myristaldehyde	$C_{14}H_{28}O$	212
31	20.350	215214	0.88	Cyclobutanecarboxylic acid, undec-2-enyl ester	$C_{16}H_{28}O_2$	252
32	20.494	137941	0.56	6-Methyl-2-heptyl methylphosphonofluoridate	$C_9H_{20}FO_2P$	210
33	20.646	37059	0.15	Tetracosane	$C_{24}H_{50}$	338
34	21.532	72278	0.29	Sulfurous acid, 2-ethylhexyl isohexyl ester	$C_{14}H_{30}O_3S$	278
35	21.937	96985	0.40	Palmitaldehyde	$C_{16}H_{32}O$	240
36	22.222	208800	0.85	Di-n-octyl phthalate	$C_{24}H_{38}O_4$	390
37	23.582	579769	2.37	Tetratriacontane	$C_{34}H_{70}$	478
38	24.833	80973	0.33	Heptadecane, 2,6,10,15-tetramethyl-	$C_{21}H_{44}$	296
39	25.044	91195	0.37	1,1'-Bicyclopropyl]-2-octanoic acid, 2'-hexyl-, methyl ester	$C_{21}H_{38}O_2$	322
40	25.440	148053	0.60	Squalene	$C_{39}H_{50}$	410
41	26.078	36402	0.15	2-Piperidinone, N-[4-bromo-n-butyl]-	$C_9H_{16}BrNO$	233
42	26.329	1030785	4.21	Nonacosane	$C_{29}H_{60}$	408
43	26.769	57747	0.24	3-Keto-isosteviol	$C_{20}H_{28}O_4$	332
44	28.100	51936	0.21	Oxalic acid, 6-ethyloct-3-yl heptyl ester	$C_{19}H_{36}O_4$	328
45	29.093	102152	0.42	Ethyl iso-allocholate	$C_{26}H_{44}O_5$	436
46	29.752	216705	0.88	β, β-Carotene	$C_{40}H_{56}$	536
47	30.015	319936	1.31	β-Tocopherol	$C_{28}H_{48}O_2$	416
48	30.282	1484548	6.06	Heptacosane	$C_{27}H_{56}$	380
49	30.908	129997	0.53	Cholesta-4,6-dien-3-ol, (3β)-	$C_{27}H_{44}O$	384
50	31.259	388277	1.58	Stigmasta-5,22-dien-3-ol, acetate, (3β)-	$C_{31}H_{50}O_2$	454
51	31.506	348989	1.42	Vitamin E (α-Tocopherol)	$C_{29}H_{50}O_2$	430
52	33.573	257991	1.05	Pentafluoropropionic acid, heptadecyl ester	$C_{20}H_{35}F_5O_2$	402
53	33.702	854914	3.49	Campesterol	$C_{28}H_{48}O$	400
54	33.904	666536	2.72	Celidoniol, deoxy	$C_{29}H_{60}$	408
55	34.340	2539479	10.36	Stigmasterol	$C_{29}H_{48}O$	412
56	34.789	67022	0.27	Cholestan-3-one, (5.alpha.)-	$C_{27}H_{46}O$	386
57	34.967	139989	0.57	Disulfide, di-tert-dodecyl	$C_{24}H_{50}S_2$	402
58	35.545	1320403	5.39	β-Sitosterol	$C_{29}H_{50}O$	414
59	35.912	332415	1.36	Acetic acid, 3-hydroxy-7-isopropenyl-1, 4a-dimethyl-2,3,4,4a,5,6,7,8-octahydronaphthalen-2-yl ester	$C_{17}H_{26}O_3$	278
60	36.184	114705	0.47	Longifolenaldehyde	$C_{15}H_{24}O$	220
61	36.473	294977	1.20	Ergosta-7,22-dien-3-ol, (3.beta.,22E)-	$C_{28}H_{46}O$	396
62	36.582	410130	1.67	Cholest-4-en-3-one	$C_{27}H_{44}O$	384
63	36.743	96177	0.39	Cholestane-2,3-diol, 3-acetate	$C_{29}H_{50}O_3$	446
64	36.970	827334	3.38	Lupeol (Fagarsterol)	$C_{30}H_{50}O$	426
65	37.313	1665468	6.80	4,22-Stigmastadiene-3-one	$C_{29}H_{46}O$	410
66	37.621	99227	0.40	2(1H)Naphthalenone, 3,5,6,7,8,8a-hexahydro-4,8a-dimethyl-6-(1-methylethenyl)-	$C_{15}H_{22}O$	218
67	37.801	147285	0.60	Stigmasta-3,5-dien-7-one	$C_{29}H_{46}O$	410
68	38.306	1029071	4.20	9,19-Cyclolanost-25-ene-3-ol, 24-methyl-, (3β, 24S)-	$C_{31}H_{52}O$	440
69	38.790	1436663	5.86	Stigmast-4-en-3-one	$C_{29}H_{48}O$	412
70	39.729	126009	0.51	Oxalic acid, 6-ethyloct-3-yl isobutyl ester	$C_{16}H_{30}O_4$	286
71	40.341	101332	0.41	Ergost-25-ene-3,5,6,12-tetrol, (3β, 5α,6β, 12β)-	$C_{28}H_{48}O_4$	448
72	40.749	82938	0.34	Stigmasta-5,22-diene, 3-methoxy-, (3β, 22E)-	$C_{30}H_{50}O$	426
73	41.828	274488	1.12	7-Tetradecenal, (Z)-	$C_{14}H_{26}O$	210
74	43.800	293860	1.20	Cholest-4-ene-3,6-dione	$C_{27}H_{42}O_2$	398
		24506956	100.00			

TABLE 2: Compounds identified in the acetone extract of *Cenchrus ciliaris* showing nature and activity

P	R. T.	Compound name	Nature of Compound	Activity
1	6.203	Pantolactone	Chemical intermediate for the synthesis of Vitamin B5	Cosmetic applications (Cosmetic ingredients used in skin creams, shampoos)
2	7.966	Hexylene Glycol	Alcoholic compound	Antimicrobial Preservative
3	14.047	Oxalic acid, isobutyl pentyl ester	Ester compound	Antimicrobial (Antifungal) Preservative
4	16.081	Phthalic acid, butyl undecyl ester	Ester compound	Antimicrobial Activity
5	17.253	Hexadecanoic acid, 2-oxo-, methyl ester	Ester compound	Antimicrobial Activity
6	17.383	Decanoic acid, propyl ester	Ester compound	Antimicrobial Activity
7	18.318	Phytol	Diterpene	Antimicrobial, Anti-inflammatory, Anticancer, Diuretic
8	20.119	Myristaldehyde	Aldehyde Compound	Antimicrobial Activity
9	20.350	Cyclobutanecarboxylic acid, undec-2-enyl ester	Ester compound	Antimicrobial Activity
10	21.532	Sulfurous acid, 2-ethylhexyl isohexyl ester	Ester compound	Antimicrobial Activity
11	21.937	Palmitaldehyde	Aldehyde Compound	Antimicrobial Activity
12	22.222	Di-n-octyl phthalate	Plasticizer compound	Antimicrobial Antifouling
13	25.440	Squalene	Triterpene	Antibacterial, Antioxidant, Anti-tumor, Cancer preventive, Immuno-stimulant, Chemo preventive, Lipoxygenase-inhibitor, Pesticide Diuretic
14	26.769	3-Keto-isosteviol	Alcoholic compound	Antimicrobial Activity
15	28.100	Oxalic acid, 6-ethyloct-3-yl heptyl ester	Ester compound	Antimicrobial Activity
16	29.093	Ethyl iso-allocholate	Steroid	Antimicrobial, Diuretic, Anti-inflammatory, Anti-asthma
17	29.752	β-Carotene	Pigment	lowering cholesterol
18	30.015	β-Tocopherol	Steroid	lowering cholesterol
19	30.908	Cholesta-4,6-dien-3-ol, (3β)-	Steroid	Antimicrobial, Diuretic, Anti-inflammatory, Anti-asthma
20	31.259	Stigmasta-5,22-dien-3-ol, acetate, (3β)-	Ester compound	Antimicrobial Activity
21	31.506	Vitamin E (α-Tocopherol)	Steroid	lowering cholesterol
22	33.573	Pentafluoropropionic acid, heptadecyl ester	Ester compound	Antimicrobial Activity
23	33.702	Campesterol	Steroid	Anti-tumor, Cancer preventive, inhibit intestinal cholesterol absorption, Anti-inflammatory
24	34.340	Stigmasterol	Steroid	Anti-tumor, Cancer preventive, inhibit intestinal cholesterol absorption. Anti-inflammatory
25	35.545	β-Sitosterol	Steroid	Anti-tumor, Cancer preventive, inhibit intestinal cholesterol absorption. Anti-inflammatory
26	36.184	Longifolenaldehyde	Aldehyde compound	Antimicrobial activity
27	36.473	Ergosta-7,22-dien-3-ol, (3.beta.,22E)-	Steroid	lowering cholesterol
28	36.582	Cholest-4-en-3-one	Steroid	Antimicrobial activity
29	36.743	Cholestane-2,3-diol, 3-acetate	Ester compound	Antimicrobial activity
30	36.970	Lupeol (Fagarsterol)	Steroid	Anti-tumor, Cancer preventive, inhibit intestinal cholesterol absorption. Anti-inflammatory

DISCUSSION

Among the identified phytochemicals (table-1 & 2) squalene has the property of antioxidant (Kala *et al*., 2011). Recently squalene possesses chemo-preventive activity against colon carcinogenesis (Rao *et al*., 1998). Phytol is detected in Polygala javana whole plant which was also found to be effective at different stages of the arthritis (Alagammal *et al*., 2012). It was found to give food as well as preventive and therapeutic results against arthritis. The results show that, reactive oxygen species-promoting substances such as phytol constitute a promising novel class of pharmaceuticals for the treatment of rheumatic arthritis and possibly other chronic inflammatory diseases (Ogunlesi *et al*., 2009). Progesterone also inhibits the conversion of testosterone to dihydrotestosterone and stimulates the activity of p53, thereby finds application in prostate cancer therapy (Mercola, 1998; South, 2012). Research has indicated that stigmasterol may be useful in prevention of certain cancers, including ovarian, prostate, breast and colon cancers. Studies with laboratory animals fed with stigmasterol suggest a decrease of 23% in the cholesterol absorption over a 6-week period. It inhibits several pro-inflammatory and matrix degradation mediators typically involved in osteoarthritis-induced cartilage degradation (Gabay *et al*., 2010). It also exhibits potent antioxidant, hypoglycemic and thyroid inhibiting properties (Panda *et al*., 2009). Beta-sitosterol and stigmasterol inhibit prostate cancer growth by increasing p53 protein expression and also inhibit carcinoma development by decreasing p21 and p27 protein expression (Scholtysek *et al*., 2009). Gamma-Sitosterol is a C-24 isomer of beta-Sitosterol (Grae me, 1963). According to Duke's ethanobotanical and phytochemistry database (Jim Duke, 1998), beta-Sitosterol and amyrin derivative, 12-Oleanen-3-yl acetate, (3alpha) possess antioxidant, anti-inflammatory and antitumor activities.

CONCLUSION

Therapeutic mechanism of a plant can be better understood with a proper investigation of its active ingredients. In the present study, 74 components from the acetone extracts of the whole plant of *C. ciliaris* were identified by GC-MS analysis. The presence of various bioactive compounds justifies the use of this plant for various ailments by traditional practitioners. These active principles provide inspiration for further investigation to achieve lead molecules in the discovery of novel herbal drugs. However, isolation of individual photochemical constituents and subjecting it to biological activity will definitely give fruitful results. It could be concluded that, *C. ciliaris* contains various bioactive compounds. So it is recommended as a plant of phyto-pharmaceutical importance. However, further studies are needed to undertake its bioactivity and toxicity profile.

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