GC-MS analysis of bioactive compounds in the plant parts of methanolic extracts of *Momordica cymbalaria* Fenzl

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**Abstract**

Plants are excellent sources of secondary metabolites that have been used for the treatment of human diseases. The plant *Momordica cymbalaria* contains different types of phytochemicals like phenols, steroids, flavonoids, alkaloids and tannins. The present investigation was carried out to determine the bioactive compounds present in the different plant parts of *Momordica cymbalaria* by Gas chromatography-mass spectroscopy (GC-MS) technique. Chromatograms and bioactive compounds of *in vivo* leaf, root and *in vitro* leaf callus methanolic extracts of *Momordica cymbalaria* are derived by GC-MS technique. 37 compounds were found in leaf methanolic extracts, 20 compounds in *in vitro* leaf callus methanolic extracts and 18 compounds in root methanolic extracts. These are important bioactive compounds containing secondary metabolites like phenols, steroids, flavonoids, alkaloids and tannins. The present investigation was carried out to determine the bioactive compounds present in the different plant parts of *Momordica cymbalaria* by Gas chromatography-mass spectroscopy (GC-MS) technique. Chromatograms and bioactive compounds of *in vivo* leaf, root and *in vitro* leaf callus methanolic extracts of *Momordica cymbalaria* are derived by GC-MS technique. 37 compounds were found in leaf methanolic extracts, 20 compounds in *in vitro* leaf callus methanolic extracts and 18 compounds in root methanolic extracts. These are important bioactive compounds containing secondary metabolites like phenols, steroids, flavonoids, alkaloids and tannins.

**Keywords:** Gas chromatography-mass spectroscopy (GC-MS), biomolecules, *In vitro*, *In vivo*, methanolic extract

1. **Introduction**

Human beings consuming foods contain different types of minor, major components and bioactive molecules like carbohydrates, peptides, antioxidants, lipids and glucosinolates. Plants produced vegetables and fruits are containing some useful bioactive molecules, these are act as antioxidants in human body which are helpful in skin damage control, oxidative damage cell control and prevent the cancer cell formation.

According to the Roessner and Beckles, (2009) [1], the diversity of plant bioactive compounds derived from the infinite combinations of fundamental functional groups or carboxylic groups such as alkyls, hydroxyls, alcohols, steroids, aldehydes, benzyl rings that originate compounds with peculiar chemical and physical characteristics such as solubility, melting point, and reactivity. Plants produced Bioactive molecules are compounds having pharmacological or toxicological effects. Vitamins, minerals and nutrients were obtain pharmacological or toxicological effects when taken in high doses. In plants Vitamins, minerals and nutrients are generally not mentioned as bioactive compounds. Plants produced secondary metabolites are termed as bioactive compounds or bioactive molecules. Hence, a definition of bioactive compounds in plants referred as secondary plant metabolites obtaining the pharmacological or toxicological effects in human beings and animals. According to Gomathi et al., 2015 [2], "Bioactive molecules" are compounds that occur in nature, part of the food chain, capable of interacting with one or more compounds of living tissue, exerting a synergistic effect on human health. According to korhonen, (2002) [3], to detect the bioactive compounds in plants must perform the extraction or separation techniques and recovery techniques by taking bio accessibility measurements. These bioactivity measurements like *In vivo*, *In vitro* are based on the bioactive components interacts with biomolecules. This interaction generates an metabolites.
Extraction is the first step of any role on the final result of the study. Extraction methods are also called as “sample preparation techniques”. Now-a-days modern chromatographic techniques and spectrometric techniques make bioactive compound analysis easier than past days. These techniques success is depends on the nature of the plant, extraction methods and input parameters. Plant parts properties, temperature, extraction time and the solvents used as the important factors, which are affecting the extraction processes. Extraction process is the essential and it has to appropriately done for the next conducted separation, identification and characterization of biologically active compounds. Biologically active compounds can be extracted from plant material by various scientific extraction methods. Most of these methods depend on the extraction power of the various solvents used and the application of heat and mixing. Commonly used scientific methods include soxhlet, maceration, reflux extraction and hydro distillation to obtain the crude extract, which is then concentrated using a rotary evaporator (Azmir et al., 2013) [4].

After extraction process, identification and characterization of the derived compounds is important. Plant extracts usually occur as a combination of different types of phytochemicals or biologically active compounds of different polarities. Separation in the process of identification and classification of biologically active compounds still remains a major challenge. The most commonly used separation techniques for bioactive compounds are Thin layer chromatography (TLC), column chromatography (GCMS, LCMS) flash chromatography and HPLC, should be used to obtain pure compounds. The pure compounds are then used for the determination of structure and biological activity.

Phytochemical screening assay, Fourier transform infrared spectroscopy (FTIR) and Immunoassay, which use monoclonal antibodies (MAbs) are the non-chromatographic techniques. Gas chromatography Mass spectroscopy, is most commonly used and compatible technique for the identification and quantification of biomolecules. In this study we performed GCMS, to analysis methanolic plant extracts of Momordica cymbalaria Fenzl. The present investigation has helped to identify seventy five (75) bioactive chemical constituents from in vivo leaf, root and in vitro leaf callus methanolic extracts of Momordica cymbalaria by using GC-MS technique. Furthermore, these screened potential bioactive compounds can be effectively used for biomedical and therapeutic applications.

2. Materials and Methods

2.1 Collection of plant material

Momordica cymbalaria plants were collected from Jammikunta crop fields, Telangana State during monsoon season. The plants were maintained and grown in the medicinal harbour at Department of Biotechnology, Kakatiya University, Telangana State, India.

2.2 Preparation of extracts

Momordica cymbalaria leaves, roots were extracted from healthy grown field plants and in vitro leaf callus were taken for this experiment. The leaves and roots were rinsed under running tap water for 15mins, washed with 10% tween 20 (liquid soap) for 5mins, then washed 4 times with double sterilized distilled water. These sterilized leaves, roots and also in vitro leaf callus were kept for shade dried for 10 days. Then they were ground to coarse powder using motor and pestle. These powders (each 10 gr) were extracted separately with methanol solvent (each 50 ml) by using cold maceration technique. Later the extracts were filtered through a Whatman filter paper and concentrated using rotary evaporator and subsequently subjected for gas chromatography mass spectroscopy (GCMS) technique using standard methods protocols. The extracts was stored in a refrigerator at 4°C for further use.

2.3 GC-MS analysis

The methanolic extracts of Momordica cymbalaria were analyzed for the presence of different volatile compounds by the technique of gas chromatography mass spectroscopy (GCMS). GCMS analysis of biologically active compounds present in the methanolic extracts of Momordica cymbalaria were performed at the Sophisticated Analytical Instrument Facility (SAIF) in IIT Bombay, Maharashtra, India. GCMS analysis of extracts was performed by using a GC-MS (GC Model: Agilent 7890A GC System, Mass Spectrometer: The Accu TOFGeV JMS- T100GeV from JEOL India Pvt. Ltd Japan). It is equipped with HP5 column (30 m in length x 0.25mm in diameter x 0.25mm film thickness). Mass range of the spectrometer was set to 35-750amu. The oven temperature was set to 280°C and Detector temperature was set to 250 °C. Helium gas was used as carrier gas and the flow rate of Helium gas was set to 1 ml/min. For GCMS detection, an electron ionization system with an ionization power of + 70eV was used. The time from injection (start time) to the time at which the eruption occurred is referred to as the retention time (RT).

2.4 Identification of Bioactive compounds

The identity of the bio constituents present in the methanolic plant extracts was assigned by the comparison of their retention time (RT) and mass spectra fragmentation patterns with those stored on the NIST Library database.

3. Results and Discussion

The GCMS analysis of Momordica cymbalaria methanolic extracts of three explants (leaf, root and in vitro leaf callus) revealed the presence of bioactive compounds. Active principles with their retention time (RT), molecular formula, molecular weight (MW), molecular structure and peak area percentage are tabulated in tables 1, 2 and 3.

3.1 Extraction of bioactive compounds

Methanol leaf extract of Momordica cymbalaria revealed the presence of thirty seven chemical constituents. The GCMS chromatogram of leaf methanolic extract is presented in fig 1. The identified compounds in the leaf extract (Table 1) are n-Hexadecanoic acid, it is reported to have an anti-inflammatory, antioxidant activities and also used as Pesticide, Nematicide (Jisha et al., 2016) [5], 9-octadecenoic acid, methyl ester, it is reported to have anti cancer properties (Syeda et al., 2011; Hema et al., 2011) [6, 7], Octadecanoic acid, methyl ester, it is showing anti-microbial properties (Gehan et al., 2009) [8], 17-Octadecynoic acid, it is reported to have anti- hypersensitive properties ((Fadeye et al., 2009) [9], 3,3-Diaminobenzidine, Aspidospermidin, 17-ol,1-acetyl-19, 21-epoxy-15,16-dimethoxy, Cholesterol, it is used as pivotal constituent of cell membranes, steroid hormones and for the function of the hedgehog protein (Herz and Bock, 2002) [10], Cholesterol, it is reported to have anti-tumor and antioxidant properties (Jinu et al., 2015) [11], E-8-methyl-9-tetradecen-1-ol acetate, Cholesterol-3ol-2-methylene, (3β-3α) it is reported as antioxidant (Israa Adnan Ibrahim et al., 2017)
Vitamin E, which is very useful bioactive compound used as antiageing, antitumour, antidiabetic, anticancer, analgesic, antidermatitis, hepatoprotective, anti-inflammatory activities (Devi and Muthu., 2015) [13], Octacosanoic acid, methyl ester, it is reported to have antibacterial activities (Zheng et al., 2005) [14]. Stigmasterol,3,4-dihydro,acetate (ester), 9,10-secocholesta-5,7,10(19)-triene-3,24,25-troil, Antihaergostan-5,7,9,22-tetraen-3-one, Ethyl iso-allocholate, it is reported to have antimicrobial and anti osteoarthritic properties (Gabay et al., 2010) [19]. B-sitosterol, it is reported to have anticancer, antimicrobial, antidiabetic, antifertility and antioxidant properties (Shirishkumar et al., 2014) [20]. 2-Butenoic acid, 2-methyl-(acetyloxy)-1,1a,2,3,4,5,6,7,10,11,11a-decahydro-7,1dihydroxy, 1, 1, 3, 6, 9, pentamethyl-4a,7a-epoxy, Methyl traicontanoate, 4, 4, 6a, 6b, 8a, 11, 11, 14 Octamethyl-1, 4-4a, 5, 6, 6a, 6b, 7, 8, 9, 10, 11, 12, 12a, 14, 14a, 14b-octadehydro-2H-picen-3-one. Lupeol, it is reported to have an antitumor, antioxidant, chemopreventive, antiarthritic (Rajendra kumar et al., 2014, Maruthupandian et al., 2011) [21,22], anti cancer (Saleem., 2009) [23], anti-inflammatory (Geetha et al., 2001) [24]. effects. Stigmata-3,5-dien-7-one, it is reported to have antiinflammatory properties (Park et al., 2016) [25]. Tert-Hexadecamethiol, it is used as enzyme activator (Rajendran et al., 2017) [26].

Table 1: GC-MS of bioactive compounds present in the methanolic extracts of leaves derived from in vivo grown plants of *Momordica cymbalaria* Fenzl.

| S. No | RT    | Compound name and Structure | Formulae | Mwt   | Area% | Biological activity                     |
|-------|-------|-----------------------------|----------|-------|-------|----------------------------------------|
| 1     | 21.77 | n-Hexadecanoic acid         | C16H32O2 | 256   | 3.78% | Anti-inflammatory, Antioxidant, Pesticide, Nematicide, Inhibitor |
| 2     | 23.98 | 9-octadecenoic acid, methyl ester | C19H36O2 | 296   | 0.38% | Anti-cancer                           |
| 3     | 24.39 | Octadecanoic acid, methyl ester | C19H38O2 | 298   | 1.14% | Anti-microbial                        |
| 4     | 24.79 | 17-octadecynoic acid        | C18H32O2 | 280   | 0.79% | Anti-hypertensive                     |
| 5     | 27.48 | 3,3-Diaminobenzidine        | C12H14N4 | 214   | 4.69% | Used in dyes & stains                 |
| 6     | 28.19 | Aspidospermidin-17-ol,1-acetyl-19, 21-epoxy-15,16-dimethoxy | C21H30N2O5 | 414 | 0.74% | No activity                           |
| 7     | 29.57 | Cholesterol                 | C27H48O  | 388   | 1.87% | Used as pivotal constituent of cell membranes |
| 8     | 29.91 | Cholestanol                 | C27H48O  | 388   | 1.76% | Anti tumor, Antioxidant activity       |
| 9     | 30.13 | E-8-methyl-9-tetradecen-1-ol acetate | C17H32O2 | 26    | 1.00% | No activity                           |
| 10    | 30.87 | Cholesterol-3ol-2-methylene,(3β-3α) | C23H53O2 | 400   | 0.66% | Antioxidant                           |
| 11    | 31.16 | Vitamin E                   | C29H50O2 | 430   | 5.00% | Antiageing, antitumour, antidiabetic, anticancer, |
| 12    | 31.50 | Octacosanoic acid, methyl ester | C29H50O2 | 430   | 14.1% | Antibacterial                         |
| No. | Percentage | Molecular Formula | Description |
|-----|------------|-------------------|-------------|
| 13  | 1.07%      | C13H28O2          | Stigmasterol, 3,4-dedihydro, acetate (ester) No activity |
| 14  | 0.27%      | C22H44O3          | 9,10-secocholesta-5,7,10(19)-triene-3,24,25-troil Involved in the regulation of calcium metabolism |
| 15  | 3.01%      | C28H40O           | Anthiaergostan-5,7,9,22-tetraen-3-one No activity |
| 16  | 0.75%      | C26H44O5          | Ethyl iso-allocholate Antimicrobial |
| 17  | 3.81%      | C27H40O4          | Spirot-8-en-11-one,3-hydroxy-(3β-5α,14β,20β,22β,25R) Anti-inflammatory, estrogentic and progestogenic effect |
| 18  | 3.44%      | C27H40O4          | 5β-cholestan-3α,7α,12α,24α,25-pentol TMS Used in primary biliary cirrhosis disease. |
| 19  | 0.60%      | C29H48O           | Cholestan-3-ol,2-methylene,(3β-5α) Antioxidant |
| 20  | 3.11%      | C28H48O2          | Stigmasterol Antiviral, Cancer preventive, Anti-inflammatory, Anti osteoarthritic |
| 21  | 1.40%      | C22H44O5          | 9,10 secocholesta-5,7,10 (19)-triene-3,24,25-triol (3β,5Z,7E) Involved in the regulation of calcium metabolism |
| 22  | 0.50%      | C27H40O4          | Spirost-8-en-11-one,3-hydroxy, (3β,5α,14 β,20 β,22 β, 25R) Anti-inflammatory, estrogentic and progestogenic effects |
| 23  | 2.23%      | C26H44O5          | Ethyl iso-allocholate Antimicrobial |
| 24  | 1.02%      | C29H50O           | Β-sitosterol Anticancer, antimicrobial, antidiabetic, antifertility, antioxidant |
| 25  | 1.20%      | C37H76O           | 2-Butenoic acid,2-methyl,2-(acetyloxy)1,1a,2,3,4,6,7,10,11,11a-decahydro7,1dihydroxy,1,1,3,6,9, pentamethyl-4a,7a-epoxy No activity |
| 26  | 4.50%      | C17H30O           | 1-Heptatriacotanol Antimicrobial |
| No. | Retention Time | Structure | Chemical Formula | Molecular Weight | Activity/Medical Use |
|-----|----------------|-----------|-----------------|------------------|---------------------|
| 27  | 37.67          | Ethyl iso-allocholate | C_{26}H_{44}O_5 | 436              | 0.64% Antimicrobial |
| 28  | 38.18          | 4,4,6a,6b,8a,11,11,14Octamethyl-1,4,4a,5,6,6a,6b,7,8,9,10,11,12,12a,14,14a,14b-octadecahydro-2H-picen-3-one | C_{30}H_{52}O_2 | 424              | 2.43% No activity   |
| 29  | 38.46          | Methyl tricatanoate | C_{31}H_{62}O_2 | 466              | 18.2% No activity   |
| 30  | 38.99          | 9,10-Secocholesta-5,7,10 (19)-triene-3,24,25-triol,(3β,5Z,7E) | C_{27}H_{44}O_3 | 416              | 1.34% Involved in the regulation of calcium metabolism |
| 31  | 39.31          | Lupeol | C_{30}H_{50}O | 426              | 0.36% Antitumor, antioxidant, chemopreventive, antiarthritic, Anti-cancer, Anti-inflammatory |
| 32  | 39.62          | 9,10,secocholeste-5,7,10 (19)-triene-3,24,25-triol (3β,5Z,7E) | C_{27}H_{44}O_3 | 416              | 0.37% Involved in the regulation of calcium metabolism |
| 33  | 40.32          | Stigmata-3,5-dien-7-one | C_{16}H_{34}S | 410              | 2.74% Anti-inflammatory |
| 34  | 41.06          | Tert-Hexadecamethiol | C_{16}H_{34}S | 258              | 2.77% Enzyme activator |
| 35  | 42.06          | 9,10,secocholeste-5,7,10 (19)-triene-1,3-diol-25-((trimethylsilyl)oxy)-(3β,5Z,7E) | C_{27}H_{52}O_3Si | 488              | 0.97% No activity |
| 36  | 42.86          | 9,10,secocholeste-5,7,10 (19)-triene-3,24,25-triol, (3β,5Z,7E) | C_{27}H_{44}O_3 | 416              | 3.40% Involved in the regulation of calcium metabolism |
| 37  | 43.32          | Lanosta-7,9 (11)-dien-18-oic acid,22,25-epoxy-3,17,20-trihydroxy-y-lactone-(3β) | C_{27}H_{44}O_3 | 484              | 1.13% Used in induction of apoptosis in human promyelocytic leukemia HL-60 cells |

**Fig 1:** Chromatogram (GC-MS) of methanolic leaf extract of Momordica cymbalaria Fenzl.
3.2 Bioactive compounds analysis from of in vitro leaf callus

In vitro leaf callus methanol extracts of *Momordica cymbalaria* revealed the presence of twenty chemical compounds. The GCMS chromatogram of *In vitro* leaf callus methanol extract is presented in fig 2. The identified compounds in the *In vitro* leaf callus extracts (Table 2) are Pyrrolidine-1-nitro, 2, pyrrolodinone, it is used as Strong solubilizing agent, used in oral medications (Strickley, 2004) [28]. 3- Aminopiperidin-2-one, Diethyl Phthalate it is reported to have an anti carcinogenic effect and it is used in skin treatments and Cosmetic products (Duty, S.M et al., 2003) [29], Cyclo hexanol,4- [(trimethylsilyloxy),cis, it is used as antioxidant (Hussein et al., 2016) [16], n-Hexadecanoic acid, 3,7-Dihydroxy-5,6-epoxycholestane, Tri cyclo [20.8.0.0(7,16)] triacontane,1(22),7(16)-diepoxo, Benz(e) azulene-3,8-dione, 5[(acetyloxy)methyl]-3a, a, 6a, 7, 9, 10, 10dihydroxy- 2, 10-dimethyl (3aa, 6aa, 10β, 10aβ, 10bβ).(+), Spirost-8-en-11-one,3-hydroxy, (3β,5a,14 β,20 β,22 β,25R), 5-(7a-Isopropenyl-4,5-dimethyl-octahydroinden-4-y)-3-methyl-pent-2-enal, Octacosanoic acid, methyl ester, Propanoic acid,2-(3-acetoxy-4,4,14-trimethyl androst-8-en-17-yl) it is reported to have an anti microbial, antitumor effects (Azhar Abdumeer Sosa et al., 2016) [30], Pentacyclo [19.3.1.1 (3,7) 1 (9,13) 1 (15,19)], Octacosal(25), 3, 5, 7 (28), 9, 11, 13 (21), 15, 17, 19 (26), 21, 23-dodecanene-25,26, 27, 28- tetroil, 5, 11, 17, 23 – tetrikis (1,1).

**Table 2:** GC-MS of bioactive compounds present in the methanolic extracts of *in vitro* leaf callus derived from in vivo grown plants of *Momordica cymbalaria* Fenzl.

| S. No | RT | Compound name and Structure | Formulae | Mwt | Area% | Biological activity |
|-------|-----|-----------------------------|----------|-----|-------|---------------------|
| 1     | 4.12| Pyrrolidine,1-nitro-        | C4H8N2O2 | 116 | 1.36% | No activity         |
| 2     | 5.11| 2, pyrrolodinone            | C4H7NO   | 85  | 2.39% | Strong solubilizing agent, used in oral medications. |
| 3     | 8.51| 3- Aminopiperidin-2-one     | C5H10N2O | 114 | 0.21% | It is possessing antimycobacterial activity. |
| 4     | 11.87| Diethyl Phthalate            | C12H14O4 | 280 | 3.52% | Anti-carcinogenic, Used in skin treatments and Cosmetic products |
| 5     | 12.68| Cyclo hexanol,4- [(trimethylsilyloxy),cis| C9H20O2Si | 188 | 2.22% | Anti-oxidant |
| 6     | 16.32| n-Hexadecanoic acid          | C16H32O2 | 256 | 2.46% | Anti-inflammatory, Antioxidant, Pesticide |
| 7     | 19.53| 3,7-Dihydroxy-5,6-epoxycholestane | C27H46O3 | 418 | 1.65% | No activity |
| 8     | 19.93| Tri cyclo [20.8.0.0(7,16)] triacontane,1(22),7(16)-diepoxo | C29H52O2 | 444 | 1.90% | No activity |
| 9     | 21.22| Benz(e)azulene3,8dione, 5[(acetyloxy)methyl]-3a,a,6a,7,9,10,10dihydroxy-2,10-dimethyl (3aa,6aa,10β,10aβ,10bβ).(+)| C10H18O6 | 348 | 1.95% | No activity |
| 10    | 22.23| Spirost-8-en-11-one,3-hydroxy, (3β,5a,14 β,20 β,22 β,25R) | C27H40O4 | 428 | 10.3% | Anti-inflammatory, estrogenic and progestogenic effects |
| 11    | 23.56| Octacosanoic acid, methyl ester | C21H32O  | 288 | 25.2% | No activity |
| 12    | 24.94| Spirost-8-en-11-one,3-hydroxy, | C27H40O4 | 438 | 2.89% | Antibacterial |
| 13    | 25.56| Spirost-8-en-11-one,3-hydroxy, | C27H40O4 | 428 | 1.33% | Anti-inflammatory, |
3.3 Bioactive compounds analysis from root methanolic extract

Methanol root extract of *Momordica cymbalaria* revealed the presence of thirty seven chemical constituents. The GCMS chromatogram of root methanolic extract is presented in fig 3. The identified compounds in the root extracts (Table 3) are 1H-pyrrole-2,5-dihydro-1-nitroso it is reported to have an antibacterial, antiviral, anti convulsant & analgesic (Azhar Abduameer Sosa *et al.*, 2016) [30] effects. 1,6-Anhydro-2,4-dideoxy-β-D-ribo-hexopyranose, 4-Hydroxy-2-methylacetato phenone, 9-Octadecenal, it is reported to have an antimicrobial, anti-inflammatory (Subavathy *et al.*, 2016) [31] effects. 6,11-Dimethyl-2,6-10-dodecatrien-1-ol, (Jisha *et al.*, 2016) [5] reported that it is having antimicrobial activity. d-Mannose, it is reported to having the capacity of Urinary tract infection prevention (Bojana Kranjcec *et al.*, 2013, Domenici *et al.*, 2016) [32,33]. Diethyl phthalate, n-Hexadecanoic acid, Triacanfanoic acid, Methyl ester, it is reported that using as antibacterial agent (Sermakkani M and Thangapandian V., 2012) [34]. 5β,7βH,10α-Eudesm-11-en-11-ol, Cyclic 20,21-(butyl boronate), (3α,5β,11β,20R)-, it is reported to have anti-inflammatory properties (Rajendran *et al.*, 2017) [26]. Oxirane, 2,2-dimethyl 1-3- (3, 7, 12, 16, 20-pentamethyl-3,7,11,15,19—

| No. | MW (g/mol) | R | Molecule Name | CAS No. | Molecular Formula | % Yield | Activity |
|-----|------------|---|----------------|---------|------------------|--------|----------|
| 14  | 28.78      | C27H42O4 | Propanoic acid, (3-acetoxy-4, 4,14-trimethyl androst-8-en-17-yl) | 430 | 7.67% | Anti-microbial, Antitumor effects |
| 15  | 29.14      | C44H56O4 | Pentacyclo [19.3.1.1(3,7)1(9,13)1(15,19)]octacosa-1(25),3,5,7(28),9,11,13(21),15,17,19(26),21,23-dodecanene-25, 26,27,28-tetrol,5,11,17,23-tetrakis(1,1) | 648 | 11.5% | No activity |
| 16  | 31.22      | C27H40O4 | Spirost-8-en-11-one, 3-hydroxy, (3β,5α,14β,20β,22β,25R) | 428 | 2.08% | Anti-inflammatory, estrogenic and progesterogemic effects |
| 17  | 32.18      | C27H40O4 | Spirost-8-en-11-one, 3-hydroxy, (3β,5α,14β,20β,22β,25R) | 428 | 3.55% | Anti-inflammatory, estrogenic and progesterogemic effects |
| 18  | 32.88      | C26H44O5 | Ethyl iso-alcocholate | 436 | 2.51% | Antimicrobial |
| 19  | 36.16      | C27H44O3 | 9,10-Secocholesta-5,7,10 (19)-triene-3,24,25-triol (3β,5Z,7E) | 416 | 5.19% | Involved in the regulation of calcium metabolism |
| 20  | 37.15      | C37H76O | 1-Heptatriacotanol | 536 | 1.73% | Antimicrobial |
heneicosapentanyll), Spirost-8-en-11-one, 3-hydroxy, C16H24O (3β, 5α, 14β, 20β, 22β, 25R) it is reported to have an antinflammatory, estrogenic and progesterogenic effects (Hussein et al., 2016) [16]. Ethyl iso-allocate it is used as an antimicrobial agent ((Malathi et al., 2106) [15]. Stigmasterol it is reported to have an antiviral, Cancer preventive (Ponnamma and Manjunath et al., 2012) [18], anti inflammatory, anti osteoarthritic (Gabay et al., 2010) [19] effects. β –sitosterol it is reported to have an anticancer, antidiabetic, anti fertility, antioxidant (Shirishkumar et al., 2014) [20] effects.

Table 3: GC-MS of bioactive compounds present in the methanolic extracts of root derived from in vivo grown plants of Momordica cymbalaria Fenzl.

| S. No | RT | Compound name and Structure | Formula | Mwt | Area% | Biological activity |
|-------|----|----------------------------|---------|-----|-------|---------------------|
| 1     | 4.12 | 1H-pyrrole-2,5,dihydro-1-nitroso | C4H6N2O | 98  | 3.84% | Antibacterial, Antiviral, anti Convulsant & analgeric |
| 2     | 4.74 | 1,6-Anhydro-2,4-dideoxy-β-D-ribo-hexopyranose | C6H10O3 | 130 | 2.30% | No activity |
| 3     | 8.41 | 4-Hydroxy-2-methylacetato phenone | C6H10O2 | 150 | 2.55% | No activity |
| 4     | 10.06 | 9-Octadecenal | C13H24O | 266 | 1.24% | Antimicrobial, anti-inflammatory |
| 5     | 10.19 | 6,11-Dimethyl-2,6-10-dodecatrien-1-ol | C14H24O | 208 | 3.69% | Antimicrobial |
| 6     | 10.96 | d-Mannose | C6H12O6 | 180 | 2.65% | Urinary tract infection prevention |
| 7     | 11.87 | Diethyl phthalate | C12H14O4 | 222 | 11.4% | Anti-carcinogenic, Used in skin treatments and Cosmetic products |
| 8     | 16.31 | n-Hexadecanoic acid | C16H32O2 | 256 | 3.75% | Anti-inflammatory, Antioxidant, Pesticide, Nematicide, Inhibitor |
| 9     | 20.68 | Triacan tanoic acid, methyl ester | C31H52O4 | 466 | 2.19% | Antibacterial |
| 10    | 22.56 | 5β,7βH,10α-Eudesm-11-en-1α-ol | C30H50O2 | 426 | 9.85% | No activity |
| 11    | 23.54 | Pregnane-3,11,20,21-tetrol, cyclic 20,21-(butyl boronate), (3α,5β,11β,20R)- | C31H43BO4 | 418 | 0.34% | Anti-inflammatory |
| 12    | 24.31 | Oxirane,2,2-dimethyl-3-(3,7,12,16,20-pentamethyl-3,7,11,15,19—heneicosapentanyll) | C36H60O5 | 436 | 0.93% | Anti-inflammatory |
| 13    | 24.63 | Spirost-8-en-11-one,3-hydroxy, (3β,5α,14β,20β,22β,25R) | C27H40O4 | 428 | 6.05% | Anti-inflammatory, estrogenic and progesterogenic effects |
| 14    | 26.0 | Spirost-8-en-11-one,3-hydroxy, (3β,5α,14β,20β,22β,25R) | C27H40O4 | 428 | 1.90% | Anti-inflammatory, estrogenic and progesterogenic effects |
| 15    | 32.15 | Spirost-8-en-11-one,3-hydroxy, (3β,5α,14β,20β,22β,25R) | C27H40O4 | 428 | 2.87% | Anti-inflammatory, estrogenic and progesterogenic effects |
| 16    | 35.49 | Ethyl iso-allocate | C26H44O5 | 436 | 0.93% | Antimicrobial |
4. Conclusion
The present investigation helps to identify seventy five bioactive chemical constituents from leaf, root and in vitro leaf callus methanolic extracts of *Momordica cymbalaria* Fenzl. by GCMS technique. Our study enhances the traditional usage of which possesses some known and unknown bioactive compounds. Identified bioactive compounds may subjecting to pharmaceutical area is useful to making of new drugs.

5. Acknowledgement
The author’s gratefully acknowledges research financial support for this publication from the UGC, SAP-DRS-II, New Delhi.

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