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Research Article

Identification of Insecticidal Components of *Mango Ginger* Rhizome and *Tagetes erecta* Flower Extracts by GC-MS Analysis

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ABSTRACT

The insecticidal compounds of *Mango ginger* (*Curcuma amada*) rhizome and *Tagetes erecta* flowers were investigated using Gas Chromatogram/Mass spectral (GC-MS). The compounds found in the extracts were matched with the databases available in National Institute of Standards and Technology (NIST) library and were confirmed. The ethanolic extract of *mango ginger* rhizome was subjected to GC-MS analysis, which ensured the presence of twenty four compounds. Further, the analysis revealed the existence of β-Sitosterol (1.03%) and Androstan-17-one (93.67 %), 3-ethyl-3-hydroxy-, β-Sitosterol - these compounds are having insecticidal activities. Analysis of ethanol extract of *Tagetes erecta* flowers led to the identification of 13 active compounds, which include stigmasterol (6.78%), α-Sitosterol (5.26%), α-Amyrin (43.89%) and hexadecanoic acid ethyl ester (0.45%) and these compounds are having insecticidal activities. The present study demonstrates that *Mango ginger* rhizome and *Tagetes erecta* flower are having the potent insecticidal compounds.

Keywords: *Mango ginger*, *Tagetes erecta,* GC-MS analysis, Insecticidal activity, Phytochemicals

1. INTRODUCTION

Most traditional medicines are developed from nature. Plants are rich source of secondary metabolites with exciting insecticidal activities. It is also helpful in the treatment of asthma, bronchitis, cough etc[1]. Sterols have been analyzed to investigate the sterol source in *Laodelphax striatellus* and three other rice plant-sucking homopterous insects. In *L. striatellus*, cholesterol, 24-methylenecholesterol and β-sitosterol have been detected[2]. Another study has dealt with the diversity analysis in mango ginger (*C. amada*) especially from Myanmar. Though, the genotypes investigated are less in number even then a high polymorphism has been revealed in this study[3.]

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Synthesis and accumulation of bioactive compounds along with other soluble and storage components have been investigated during developmental stages of mango ginger rhizome from 60 to 240 days[4]. The MAE of mangiferin from *Curcuma amada* using ethanol can be safely employed in food and medicinal industries as it is not only efficient from the industrial point of view, but also eco friendly since it prevents environmental hazards[5]. The purified compound also exhibits antioxidant activity, cytotoxicity and platelet aggregation inhibitory activities[6]. The rhizome is rich in essential oils, and more than 130 chemical constituents with biomedical significance have been isolated from it. Its antibacterial, inecticidal, and antifungal and antioxidant properties have been investigated[7]. Identification and determination of (anti-tubercular agent) labdane diterpene dialdehyde in *C. amada* rhizome samples of different geographic locations has been reported[8]. Sterols were analysed to investigate the sterol source in *Laodelphax striatellus* and three other rice plant-sucking homopterous insects. From the honeydew excreted by *L. striatellus*, cholesterol, β-sitosterol and negligible amounts of campesterol have been recovered. *Laodelphax striatellus* possesses yeastlike symbiotes which can be destroyed by high temperature[9]. Sterol and ecdysteroid content in the house fly, *Musca domestica* (L.) has also been repored[10]. In the present study, the bioactive components of *Mango ginger* rhizome and *Tagetes erecta* flowers have been evaluated using Gas Chromatography Mass spectrometer technique (GC-MS).

2. MATERIAL AND METHODS

2.1 Plant material and extraction procedure

Mango ginger rhizome and *Tagetes erecta* flowers were collected from various gardens in Keelavandanviduthy Village, Pudukkottai district, Tamilnadu, India. The powdered rhizome and flowers material (20 g) was soaked in 50 ml of 80% alcohol for 12 hours and then filtered through a Whatmann filter paper along with 2 g sodium sulphate to remove the sediments and traces of water in the filtrate. Before filtering, the filter paper along with sodium sulphate was wetted with absolute alcohol. The filtrate was then concentrated by bubbling nitrogen gas into the solution and concentrated to 1 ml.

2.2 Gas Chromatography- Mass Spectrum Analysis (GC-MS)

GC-MS technique was used in this study to identify the phytocomponents present in the extract. GC-MS technique was carried out at Indian Institute of Crop Processing Technology (IICPT), Thanjavur, Tamilnadu. GC-MS analysis of this extract was performed using a Perkin Elmer GC Claurus 500 system and gas chromatograph interfaced to a Mass Spectrometer equipped with Elite-1 fused silica capillary column (30 m x 1μ Mdf. Composed of 100% Dimethyl polysiloxane). For GC-MS detection, an electron ionization energy system with ionization energy of 70 eV was used. Helium gas (99.999%) was used as the carrier gas at a constant flow rate of 1 ml/min. and an injection volume of 2 μl was employed (split ratio of 10:1) at Injector temperature 250 °C and Ion-source temperature 280 °C. The oven temperature was programmed from 110 °C (isothermal for 2 min.), with an increase of 10 °C /min, to 200 °C, then 5 °C/ min. to 280 °C, ending with a 9 min. isothermal at 280 °C. Mass spectra were taken at 70 eV; a scan interval of 0.5 seconds and fragments from 45 to 450 Da. Total GC running time was 36 min. The relative percentage 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 Turbo Mass Ver 5.2.0.

2.3 Identification of components

Interpretation of mass spectrum GC-MS was conducted using the database of National Institute Standard and Technique (NIST) having more than 62,000 patterns. The spectrum of the unknown component was compared with the spectrum of the known components stored in the NIST library. The Name, Molecular weight, Structure of the component of the test material was ascertained.

3. RESULT AND DISCUSSION

3.1 Mango ginger rhizome

Twenty four compounds were identified in mango ginger rhizome extract by GC-MS analysis. The active principle Molecular Weight (MW), Concentration (%), Molecular Formula (MF), Retention Time (RT) and their bioactivity are presented in Figure 1 and Table1 The prevailing compounds were α-Sitosterol (1.03%) and Androstan(-17-one, 3-ethyl-3-hydroxy-, (5α) –) is first report in the GC-MS analysis of *mango ginger* rhizome .the presence of various bioactive compounds justifies the use of the plant rhizome for various medicine by traditional practitioners.

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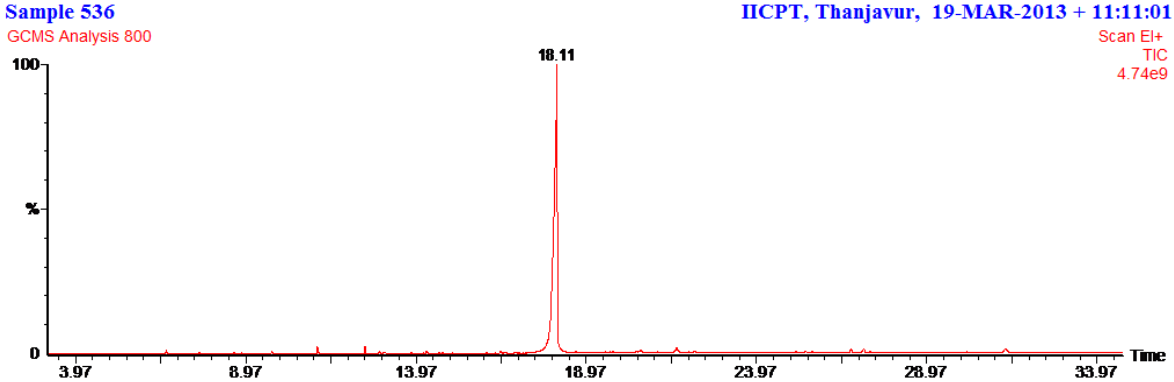

Figure 1: Chromatogram obtained from the GC- MS with the extract of *Mango Ginger* rhizome

Table 1: Composition of chemicals and biological activity in *Mango Ginger* rhizome through GC-MS study

No.	RT	Name of the compound	Molecular formula	MW	Peak Area %	Compound Nature	@Activity
1	6.63	Caryophyllene	$C_{15}H_{24}$	204	0.23	Sesquiterpene	Anti-tumor, Analgesic Antibacterial, Anti-inflammatory Sedative, Fungicide
2	7.08	α-Caryophyllene	$C_{15}H_{24}$	204	0.02	Sesquiterpene	Anti-tumor, Analgesic Antibacterial, Anti-inflammatory Sedative, Fungicide
3	7.61	2-Bromomethyl-1-isopropenyl-3-methyl-cyclopentane	$C_{10}H_{17}Br$	216	0.06	Bromine compound	Antimicrobial
4	8.64	Caryophyllene oxide	$C_{15}H_{24}O$	220	0.08	Sesquiterpenoid	Anti-tumor, Analgesic Antibacterial, Anti-inflammatory Sedative, Fungicide
5	8.84	Benzene, ethoxy- [Synonyms: Phenetole]	$C_8H_{10}O$	122	0.05	Ether compound	No activity reported
6	9.73	cis-Z-à-Bisabolene epoxide	$C_{15}H_{24}O$	220	0.13	Sesquiterpenoid	Anti-tumor, Analgesic Antibacterial, Anti-inflammatory Sedative, Fungicide
7	11.07	3-Cyclohexene-1-carboxaldehyde, 1,3,4-trimethyl-	$C_{10}H_{16}O$	152	0.59	Monoterpenoid	Anti-tumor, Analgesic Antibacterial, Anti-inflammatory Sedative, Fungicide
8	11.85	1,6,10-Dodecatriene, 7,11-dimethyl-3-methylene-, (Z)- [Synonyms: (Z)-α-Farnesene]	$C_{15}H_{24}$	204	0.02	Sesquiterpenoid	Anti-tumor, Analgesic Antibacterial, Anti-inflammatory Sedative, Fungicide
9	12.47	(E,E,E)-3,7,11,15-Tetramethylhexadeca-1,3,6,10,14-pentaene	$C_{20}H_{32}$	272	0.57	Hydrocarbon	No activity reported
10	12.89	(E,E)-7,11,15-Trimethyl-3-methylene-hexadeca-1,6,10,14-tetraene	$C_{20}H_{32}$	272	0.19	Hydrocarbon	No activity reported
11	13.01	1,3-Bis-(2-cyclopropyl,2-methylcyclopropyl)-but-2-en-1-one	$C_{18}H_{26}O$	258	0.06	Ketone compound	No activity reported
12	13.84	1,6,10,14-Hexadecatetraen-3-ol, 3,7,11,15-tetramethyl-, (E,E)-	$C_{20}H_{34}O$	290	0.09	Terpene alcohol	Antimicrobial Anti-inflammatory
13	14.27	6,11-Dimethyl-2,6,10-dodecatrien-1-ol	$C_{14}H_{24}O$	208	0.26	Alcoholic compound	Antimicrobial
14	14.64	11-Hexadecynal	$C_{16}H_{28}O$	236	0.05	Aldehyde	Antimicrobial
15	14.76	Preg-4-en-3-one, 17à-hydroxy-17á-cyano-	$C_{20}H_{27}NO_2$	313	0.06	Nitrogen compound	Antimicrobial
16	15.04	8,11,14-Eicosatrienoic acid, (Z,Z,Z)-	$C_{20}H_{34}O_2$	306	0.06	Unsaturated fatty acid	Anticholesterol
17	16.04	3-Bromo-7-methyl-1-adamantanecarboxylic acid	$C_{12}H_{17}BrO_2$	272	0.08	Bromine compound	Antimicrobial
18	16.45	3-Buten-2-ol, 3-methyl-4-(2,6,6-trimethyl-2-cyclohexen-1-yl)-	$C_{14}H_{24}O$	208	0.17	Alcoholic compound	Antimicrobial
19	18.11	Androstan-17-one, 3-ethyl-3-hydroxy-, (5à)-	$C_{21}H_{34}O_2$	318	93.67	Steroid	Antimicrobial, Anticancer, Anti-inflammatory, Antiasthma, Diuretic , Antiarthritic, Insecticide
20	21.63	Bicyclo[8.2.0]dodecan-11-one, 12,12-dichloro-, (1R*,10S*)-	$C_{12}H_{18}Cl_2O$	248	1.15	Chlorine compound	Antimicrobial
21	25.12	2-[4-methyl-6-(2,6,6-trimethylcyclohex-1-enyl)hexa-1,3,5-trienyl]cyclohex-1-en-1-carboxaldehyde	$C_{23}H_{32}O$	324	0.29	Aldehyde	Antimicrobial
22	26.74	Olean-12-en-28-al, cyclic 1,2-ethanediyl mercaptal	$C_{32}H_{52}S_2$	500	0.45	Sulphur compound	Antimicrobial
23	27.12	1,3-Dithiolane, 2-(28-norurs-12-en-17-yl)-	$C_{32}H_{52}S_2$	500	0.63	Sulphur compound	Antimicrobial
24	31.27	β-Sitosterol	$C_{29}H_{50}O$	414	1.03	Steroid	Antimicrobial, Anticancer, Anti-inflammatory, Antiasthma, Diuretic, Antiarthritic, Insecticide, Insecticide

3.3 Tagetes erecta flowers

Interpretation on mass spectrum GC-MS was conducted using the database of National Institute Standards and Technology (NIST) having more than 1,50,000 patterns. The spectrum of the unknown compound was compared with the spectrum of the known components stored in the NIST library. Thirteen compounds have been identified in *T. erecta* flower extract by GC-MS analysis. The active principles with their retention time (RT), Molecular Weight (MW), Molecular Formula (MF), and peak area (%) are presented in (Table 2). Our results reveal that thirteen active compounds have been isolated from *T.erecta* flower by GC-MS and all these compounds have been reported as medicinal value except the alkaline compounds[13]. Stigmasterol (6.78 %), α-Sitosterol (5.26%), α-Amyrin (43.89%) and Hexadecanoic ethyl ester (0.45%) are the compounds referred to have insecticidal activities (Fig. 2)

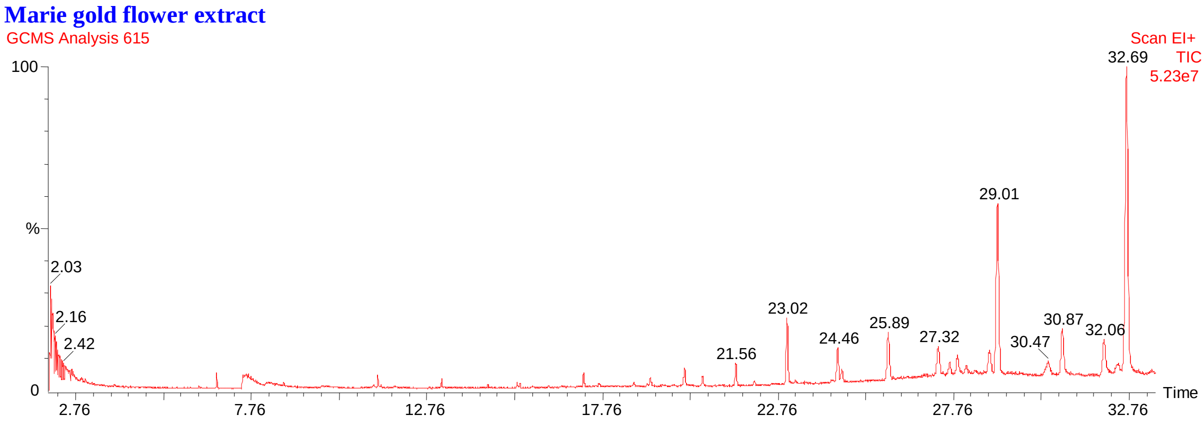

Figure 2: Chromatogram obtained from the GC/MS with the extract of *Tagetes erecta* flower extract

Table 2: Activity of Components identified in the *Tagetes erecta* flower extract [GC MS study]

No.	RT	Name of the compound	Molecular formula	MW	Peak Area %	Compound Nature	**Activity
1	6.77	1,6,10- dodecatriene, 7,11-dimethyl-3-methylene	$C_{15}H_{24}$	204	0.54	Sesquiterpene	Antimicrobial Anti inflammatory
2	7.67	Sucrose	$C_{12}H_{22}O_{11}$	342	1.16	Sugar moiety	Preservative
3	11.36	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	$C_{20}H_{40}O$	296	0.54	Terpene Alcohol	Antimicrobial Anti-inflammatory
4	13.17	Hexadecanoic acid, ethyl ester	$C_{18}H_{36}O_2$	284	0.45	Palmitic acid ester	Antioxidant Hypocholesterolemic Nematicide, Insecticide Lubricant, .Antiandrogenic Flavor, Hemolytic 5-Alpha reductase inhibitor
5	21.56	1-Iodo-2-methylundecane	$C_{12}H_{25}I$	296	1.78	Iodo compound	Antimicrobial
6	23.02	Trifluoroacetic acid, n-octadecyl ester	$C_{20}H_{37}F_3O_2$	366	5.71	Ester compound	Antimicrobial
7	24.46	Heptacosane	$C_{27}H_{56}$	380	2.94	Alkane compound	No activity reported
8	25.89	Eicosane, 2-methyl-	$C_{21}H_{44}$	296	5.44	Alkane compound	No activity reported
9	27.32	Eicosane, 7-hexyl-	$C_{26}H_{54}$	366	3.93	Alkane compound	No activity reported
10	29.01	Vitamin E	$C_{29}H_{50}O_2$	430	21.59	Vitamin compound	Antiageing, Analgesic,Antidiabatic Anti-inflammatory, Antioxidant, Antidermatitic, Antileukemic, Antitumor, Anticancer, Hepatoprotective, Hypocholesterolemic, Antiulcerogenic, Vasodilator, Antispasmodic , Antibronchitic, Anticoronary
11	30.87	Stigmasterol	$C_{29}H_{48}O$	412	6.78	Steroid	Antimicrobial Anticancer, Anti-arthritic Antiasthma Diuretic, Insecticide
12	32.06	α-Sitosterol	$C_{29}H_{50}O$	414	5.26	Steroid	Antimicrobial Anticancer, Anti-arthritic Antiasthma Diuretic, Insecticide
13	32.69	α-Amyrin	$C_{30}H_{50}O$	426	43.89	Triterpene	Antibacterial, Antioxidant Antitumor, Cancer preventive, Immuno stimulant, Chemo preventive, Lipoxygenase-inhibitor, Insecticide

**Source: Dr.Duke's: Phytochemical and Ethnobotanical Databases*

4. CONCLUSSION

The current study suggests that ethanolic extract of *Mango ginger* rhizome and *Tagetes erecta* flowers are having the potent insecticidal compounds and discovers the way for the development of several usages of regimens based on the extract. The *Mango ginger* and *Tagetes erecta* extracts as a natural insecticidal property may be used for the preparation of medicine and food materials to prevent the spoilage of food. In addition, further research is necessary to identify and purify the active compounds responsible for insecticidal activity.

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