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CHEMO-MICROSCOPY OF THE LEAVES AND GC-MS ANALYSES OF OILS FROM DIFFERENT PARTS OF *LANTANA CAMARA* LINN GROWN IN NIGERIA

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ABSTRACT
Chemo-microscopic analysis of *Lantana camara* Linn revealed the presence of lignin, starch, cellulose, oxalate crystals, tannin, oils, proteins and absence of mucilage in the leaves while the flowers showed the presence of all tested metabolites except mucilage and lignin. The GC-MS analysis of volatile oils of different parts (leaves, flowers, fruits) obtained by hydro-distillation was carried out. The total components detected in the oil of the leaf were 48, the flower oil had 49, and the fruit oil had 14 compounds, the major components common in the parts studied were: eucalyptol, beta-caryophyllene and alpha-caryophyllene. The components with the highest percentage compositions in the leaves were: gamma-terpinene (10.24%), eucalyptol (9.36%), alpha-pinene (5.82%), beta-caryophyllene (5.13%). In the flowers the components that had the highest composition were: eucalyptol (7.65%), trans-nerolidol (7.17%), beta-caryophyllene (6.95%), sabinene (6.29%), 14-hexadecatetraenyl acetate (5.82%), alpha-caryophyllene (5.81%) and in the fruits the components that had the highest composition were: phytol (23.04%), octadec-9-enoic acid (15.50%), beta-caryophyllene (13.57%), sabinene (9.66%), n-hexadecanoic acid (9.51%), alpha-caryophyllene (6.97%) and trans-nerolidol (6.93%). The chemo-microscopic and GC-MS characterization of *Lantana camara* can be used for identification and quality control of the *L. camara* as a crude drug. Volatile oil constituents found in the different parts of the plant find applications in flavorings, fragrances or perfumery, cough suppressant, manufacture of cosmetic products, manufacture of detergents, soaps, emulsifying agent, manufacture of synthetic vitamin E and vitamin K1 as well as anti-inflammatory, anti-bacterial and anti-fungal agents and manufacture of aerosol product and insecticides.

KEYWORD: Chemo-microscopic analysis, *Lantata camara*, GCMS Chromatogram, Nigeria.

INTRODUCTION
Lantana camara Linn. is one of the most invasive plants and top 100 highest impacting invasive species. *Lantana camara* is also known as Lantana, Tick-berry, Wild sage, Surinam tea plant and in Nigeria it bears the following names- Ewonadele (Yoruba), Kimbamahalba (Hausa) and Anya n'nunu (Igbo) (Gabi *et al*, 2011). It grows under a wide range of climatic condition and occurs on a variety of soil types reflecting its wide ecological tolerance. The lantadenes are the major toxic components present in this plant which are responsible to cause toxicity in almost all animals thereby leading to economic loses to the farmers by causing diseases and mortality. Besides many harmful effects, this weed has many advantages. But the harmful effects often supervenes the utility of this weed. So, it is very important to develop measures to control this weed in a desirable and cost-effective way.

Lantana camara belongs to the family Verbenaceae, it is a tropical plant- a small perennial shrub and native or common to Central and Northern South American and Caribbean, it is now spread to other countries- New Zealand, Mexico, Florida, Trinidad, Jamaica, Brazil, Nigeria and many African countries. It can grow from 1 to 3 meters and it can grow 2.5 meters in width, it has tetrangular stem, stout recurved pickles and a strong odour of black currents. Leaves are ovate or ovate oblong, acute or sub-acute, crenate, serrate, rugose above and scabrid on both sides. The leaves are 3-8cm long by 3-6cm wide and green in colour. Leaves and stems are covered with rough hairs. (Sanjeeb *et al.*, 2012).

The flowers come in many different colours including; red, yellow, white, pink and orange which differ depending on location, inflorescences and age. The flower has tutti-frutti smell with a peppery undertone. After pollination occurs the colour of the flowers changes (typically from yellow to orange, pinkish or

reddish), this is believed to be a signal to pollinators that the pre-change colour contains a reward as well as being sexually viable, thus increasing pollination (Weiss& Martha, 1990). The fruit of *L. camara* is a berry-like drupe which turns from green to dark purple when matured. Green unripe fruits are inedible to human and animal alike. Because of dense patches of hard spikes on their rind, ingestion of them can result in serious damage to the digestive tract. Both vegetative (asexual) and seed reproduction occur. Up to 12,000 fruits can be produced by each plant which are then eaten by birds and other animals which can spread the seeds over large distances, facilitating the spread of *L. camara* (*L. camara*, 2008*).*

Medicinal uses of *L. camara*

Studies in India have found that *Lantana* leaves can display anti-microbial, anti-fungicidal and insecticidal properties. *L. camara* has also been used in traditional herbal medicines for treating a variety of ailments, including cancer, skin itches, leprosy, rabies, chicken pox, measles, asthma and ulcers. Some components extracted from *L. camara* served as a cough suppressant, a very effective analgesic, and for the manufacture of synthetic forms of Vitamin E and Vitamin K1. There are also some scientific studies which have shown the beneficial effects of *Lantana*, such as one by R. Satish which found that an extract from the plant reduced ulcer development in rats. Extracts from the plant have also been used in Brazil to treat respiratory infections (David, 2017). *Lantana* has been used in many parts of the world to treat a wide variety of disorders (Ross, 1999). In Central and South America, the leaves were made into a poultice to treat sores, chicken pox and measles, fevers, cold, rheumatism, asthma and high blood pressure were treated with preparation from the plant. In Ghana, an infusion of the whole plant was used for bronchitis and the powdered root in milk was given to children for stomach ache (Irvine, 1961). In Asian countries, leaves were used to treat cuts, rheumatism, ulcers and intestinal worms. It has been claimed that a steroid, lancamarone, from the leaves, exhibited cardio tonic properties (Sharma & Kaul, 1959) and that lantamine, an alkaloid from the stem, bark and roots showed antipyretic and antispasmodic properties comparable to those of quinine (Sastri, 1962). In India the leaves of the plant are boiled for tea and the decoction is a remedy against cough and it is used as a lotion for wounds and pounded leafs are applied to cuts, ulcers and swelling (Verma, 2006).

Antioxidant Activity: Ethanolic extract of *L. camara* exhibited significant antioxidant activity in in-vivo studies. The extract treatment decreased the extent of lipid peroxidation in the kidneys of urolithic rats (Reddy, 2013). The methanolic extract, some fractions and oleanolic acid DPPH (2, 2-diphenyl-1-picrylhydrazyl) radical (Ahmed, *et al.*, 2017). Leaves extracted exhibited high antioxidant effect, however younger leaves exhibited strong antioxidant activity than the older or matured leaves (Reddy, 2013). The extracts scavenged DPPH radical and prevented Fe^{2+} induced lipid peroxidation in rat's brain and homogenates and this was likely not attributed to Fe (II) chelation (Luiz, 2017).

Antimicrobial Activity: Lantana flower extract possess strong antibacterial activity, all few types yellow, lavender, red and white Lantana, flowers displayed almost similar antibacterial activities (Deepak *et al.*, 2009). The chloroform extract of Lantana showed activity against all these three strains of mycobacterium tuberculosis (Claude *et al.*, 2009). Recently, it has been reported that antimicrobial activity of the leaves extracts is active against various gram positive and gram negative bacteria (Ashish *et al*, 2011). The extract of flower, leaf, stem and roots of Lantana showed antibacterial activity against *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aurens, Staphylococcus saprophyticus (*Mary, 2011).

Antifungal and Antiviral Activity: The polymethoxylated flavone, isolated from the methanol extract of dried leaves of Lantana exhibited the antibacterial and antifungal properties (Rwangabo, 1988). In Tanzania the root bark of extract of Lantana showed an in-vitro antimalarial test with *Plasmodium falciparum* (Weenen, 1990).The essential oil containing Beta-caryophyllene, geranyl acetate, terpinyl acetate, bornylacetate and limonene remarkably inhibited the growth of many tested against fungi (Deena & Thoppil, 2000).

Antiulcerogenic Activity; Pre-treatment with methanol extract of Lantana leaves produced significant anti-ulcer effect which can be compared by aspirin induced ulcer (Thamotharan *et al.*, 2010). The methanolic extract of Lantana administered orally in pyrolic ligated induced duodenal ulcer, the Lantana showed healing of gastric ulcer and also prevent the development of duodenal ulcer in rats (Sathish *et al.*, 2011).

Mosquito Larvicidal Activity: The methanol and ethanol flower extract of Lantana was found to have higher rate of larvicidal rate against *Aedes aegypti*, where as in *Culex quinquefasciatus* variety, the concentration of extracts have to be increased for better larvicidal effect (Kumar & Maneemegalai, 2008). Essential oil obtained from the leaves of Lantana showed adulticidal activity against important vectors of malaria, dengue, dengue hemomhagic fever, yellow fever and chikungunya (Dua *et al.*, 2010).

Wound Healing Activity: A preclinical study showed Lantana is effective in healing excision wounds in the experimental animal and suggests further evaluation as a therapeutic agent in tissue repair processes associated with injuries (Shivananda *et al.*, 2008). In other study the ethanolic extract of Lantana leaf was evaluated for their wound healing potential in rates. Animals were experimentally wounded in posterior neck area and treated with thin layer of black placebo and placebo

containing 5 and 10% Lantana extract (Mahmood *et al.*, 2009).

Anthelmintic Activity; methanol extracts from the leaves, stem and roots of Lantana were investigated for their anthelmintic activity against pheritima posthuma, the methanolic extract of stems were found to be most active (Girme, 2006). Successive leaf extracts of Lantana showed significant anthelmintic activity on selected worms, ethanolic extract found to be more active compared to remaining extracts (Jitendra *et al.*, 2011).

Antipyretic Activity: Jain *et al.*, reported that Lantana ethanolic and ethyl acetate extract start lowering the body temperature from 1st to 5th hour.

MATERIALS AND METHODS

Plant material

The plant material was collected from NIPRD Compound and identified in Herbarium and Ethno-botany unit of Medicinal Plant Research and Traditional Medicine (MPR & TM) Department, NIPRD Abuja, with the voucher specimen number NIPRD/H/5619.

Chemo-microscopic analysis

Chemo-microscopic studies of the dried leaf sample was carried out using various reagent and stains such as Iodine, Sulphuric acid (66%), concentrated Hydrochloric acid, Ferric chloride, Sudan III, Ruthenium red and Phloroblucinolin HCl (1:1) to test for the presence of different metabolites (African Pharmacopoeia, 1986; Evans, 2009).

Isolation of Essential Oils by Hydro-distillation

The fresh *Lantana camara* sample was chopped into pieces and subjected to hydro-distillation for 4 hours using Clevenger-type apparatus. The essential oil obtained was dried over anhydrous sodium sulphate and used immediately for GC-MS analysis (Okhale *et al.*, 2018).

Gas Chromatography–Mass Spectrometry (GC- MS) analyses

The essential oils were analyzed by GC-MS using Shimadzu QP-2010plus GC with QP-2010plus Mass Selective Detector [MSD, operated in the EI mode (electron energy=70 eV), scan range of 45-400 amu, and scan rate of 3.99 scans/sec], and Shimadzu GCMSsolution software (version 2.53). The Gas chromatography column was HP-5MS fused silica capillary with 5% phenyl-methylpolysiloxane stationary phase, with length of 30 m, internal diameter of 0.25 mm and film thickness of 0.25 µm. The carrier gas was helium (99.99%) with flow rate of 1.61 mL/min. The oven temperature programming used was 60-180°C at a rate of 10°C/min, then held at 180°C for 2 min, followed by 18-280°C at a rate of 15°C/min, then again held at 280°C for 4 min. The injection port temperature was 250°C, ion source temperature 250°C, interface temperature 250°C while detector temperature was 280°C. Diluted sample (1/100 in hexane, v/v) of 1.0 µL was injected using autosampler and in the split mode with ratio of 20:80. Individual constituents were identified by comparing their mass spectra with known compounds and NIST Mass Spectral Library (NIST 08). The percentage of each component was reported as raw percentages based on the total ion current (Okhale *et al.*, 2018).

Qualitative and quantitative analysis

Components of the essential oil were identified by searching NIST Mass Spectral Library (NIST 11) and referring to compounds known in literature (Kasali et al., 2004). The percentage of each component was reported as raw percentage based on the total ion current.

RESULT

The chemo-microscopc analyses of the leaves and flowers is found on Table 1.The essential oil constituents of the leaves, flowers and fruits are shown in Table 2, 3 and 4 respectively. The Gas chromatography profiles of the essential oil of the leaves, flowers and fruits of *L. camara* are shown in Fig. 1, 2 & 3 respectively. The structures of some major compounds are on Figure 4.

Chemo-microscopic analysis

The chemo-microscopic analysis revealed the presence of lignin, starch, cellulose, oxalate crystals, tannin, oils, proteins and absence of mucilage in the leaves while the flowers showed the presence of all tests except mucilage and lignin.

Table 1. Chemo-microscopic analyses of the leaves and flowers of *L. camara*.

S/N	Parameters	Leaves	Flowers
1	Lignin	+	-
2	Cellulose	+	+
3	Oxalate crystals	+	+
4	Tannin	+	+
5	Starch	+	+
6	Oil	+	+
7	Mucilage	-	-
8	Protein (using picric acid)	+	+
9	Protein (using millon's reagent)	+	+

Key: + = present: - = absent

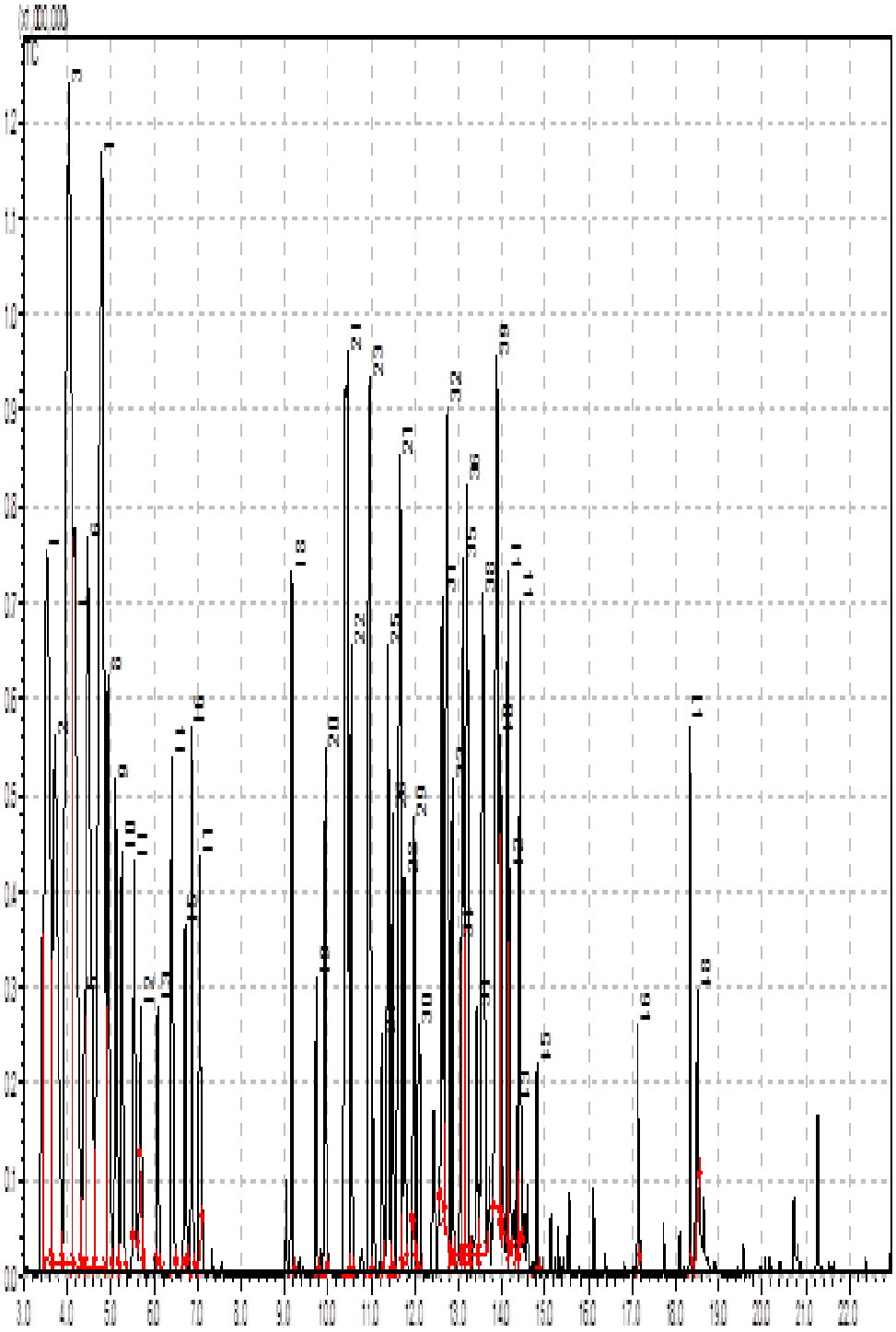

Figure 1: **GCMS Chromatogram of leaf essential oil of *Lantana camara.***

Table 2: Chromatographic profile of the essential oil of the leaves of *Lantana camara*.

S/N	Name of compound	RT	MF	%Composition
1	alpha-Pinene	3.514	$C_{10}H_{16}$	5.82
2	Camphene	3.707	$C_{10}H_{16}$	3.82
3	gamma-Terpinene	4.032	$C_{10}H_{16}$	10.24
4	beta-Pinene	4.192	$C_{10}H_{16}$	4.29
5	alpha-Phellandrene	4.375	$C_{10}H_{16}$	0.99
6	3-Carene	4.470	$C_{10}H_{16}$	4.56
7	Eucalyptol	4.796	$C_{10}H_{18}O$	9.36
8	cis-Ocimene	4.925	$C_{10}H_{16}$	1.91
9	4-Terpineol acetate	5.111	$C_{12}H_{20}O_2$	1.49
10	cis-.beta.-Terpineol	5.245	$C_{10}H_{18}O$	1.27
11	2-Carene	5.534	$C_{10}H_{16}$	0.95
12	beta.-Linalool	5.691	$C_{10}H_{18}O$	0.35
13	2,6-Dimethyl-2,4,6-octatriene	6.075	$C_{10}H_{16}$	0.60
14	Camphor	6.404	$C_{10}H_{16}O$	1.52
15	Isoborneol	6.705	$C_{10}H_{18}O$	0.81
16	Terpinene-4-ol	6.862	$C_{10}H_{18}O$	1.40
17	alpha.-Terpineol	7.047	$C_{10}H_{18}O$	0.85
18	gamma.-Elemene	9.169	$C_{15}H_{24}$	1.49
19	alpha.-Cubebene	9.734	$C_{15}H_{24}$	0.52
20	Allo-Aromadendrene	9.934	$C_{15}H_{24}$	1.38
21	beta.-Caryophyllene	10.455	$C_{15}H_{24}$	5.13
22	gamma.-Muurolene	10.528	$C_{15}H_{24}$	1.34
23	alpha.-Caryophyllene	10.962	$C_{15}H_{24}$	4.08
24	Valencene	11.244	$C_{15}H_{24}$	0.58
25	Germacrene D	11.378	$C_{15}H_{24}$	1.86
26	beta.-Selinene	11.483	$C_{15}H_{24}$	1.05
27	Germacrene B	11.662	$C_{15}H_{24}$	3.17
28	Davana ether	11.750	$C_{15}H_{22}O_2$	1.10
29	Selina-6-en-4-ol	11.983	$C_{15}H_{26}O$	0.96
30	beta.-Guaiene	12.085	$C_{15}H_{24}$	3.81
31	Davanone	12.630	$C_{15}H_{24}O_2$	1.61
32	trans-Nerolidol	12.747	$C_{15}H_{26}O$	3.72
33	3-Butyl-3-methylcyclohexanone	12.865	$C_{11}H_{20}O$	0.99
34	Germacrene D-4-ol	13.050	$C_{15}H_{26}O$	0.79
35	beta-Farnesene	13.109	$C_{15}H_{24}$	1.86
36	Caryophyllene oxide	13.205	$C_{15}H_{24}O$	2.57
37	cis-Lanceol	13.422	$C_{15}H_{24}O$	0.64
38	2-Hydroxy-5,6-epoxy-15-methyl-pregan-20-one	13.558	$C_{22}H_{34}O_3$	2.99
39	1,6,11-Hexadecatriene	13.877	$C_{16}H_{28}$	3.91
40	tau.-Cadinol	13.963	$C_{15}H_{26}O$	1.01
41	Spathulenol	14.140	$C_{15}H_{24}O$	1.69
42	Eudesm-7(11)-en-4-ol	14.183	$C_{15}H_{24}O$	0.58
43	Ledene oxide	14.363	$C_{15}H_{24}$	0.29
44	Alloaromadendrene oxide	14.423	$C_{15}H_{24}O$	1.35
45	Humulene	14.806	$C_{15}H_{24}$	0.37
46	n-Hexadecanoic acid	17.134	$C_{16}H_{32}O_2$	0.43
47	Phytol	18.334	$C_{20}H_{40}O$	0.89
48	11-Pentadecenol	18.509	$C_{15}H_{30}O$	0.57

Key: RT= Retention time; MF= Molecular formula

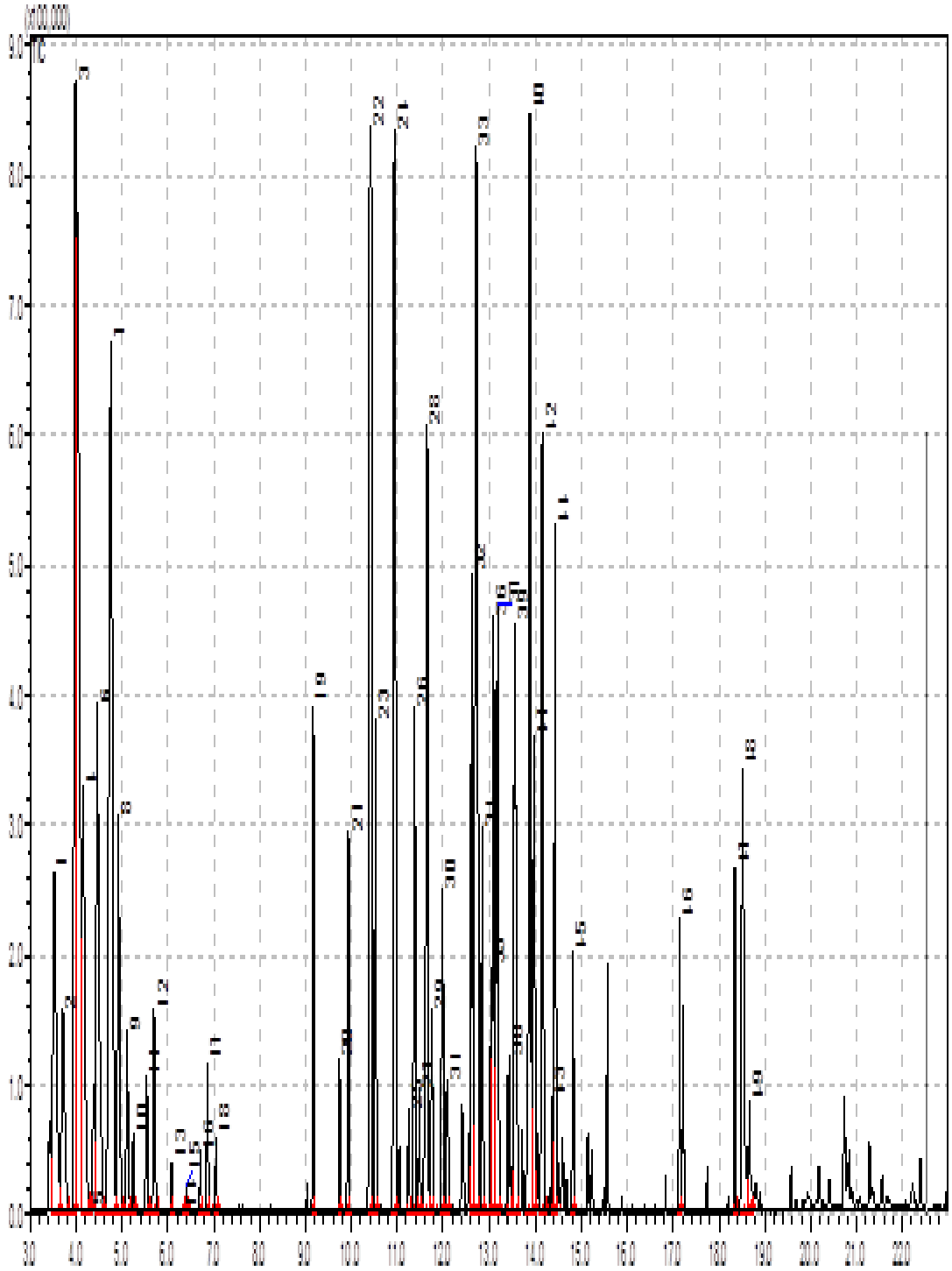

Figure 2: GCMS Chromatogram of flower essential oil of *Lantana camara.*

Table 3: Chromatographic profile of the essential oil of the flowers of *Lantana camara*.

S/N	Name of compound	RT	MF	% Composition
1	alpha.-Pinene	3.515	$C_{10}H_{16}$	3.01
2	Camphene	3.704	$C_{10}H_{16}$	1.53
3	Sabinene	3.980	$C_{10}H_{16}$	6.20
4	beta.-Myrcene	4.148	$C_{10}H_{16}$	2.76
5	alpha.-Phellandrene	4.300	$C_{10}H_{16}$	0.01
6	3-Carene	4.457	$C_{10}H_{16}$	3.68
7	Eucalyptol	4.752	$C_{10}H_{18}O$	7.65
8	3,7-Dimethyl-1,3,6-octatriene	4.917	$C_{10}H_{16}$	2.01
9	gamma.-Terpinene	5.105	$C_{10}H_{16}$	0.84
10	Terpineol, cis-.beta	5.243	$C_{10}H_{18}O$	0.30
11	4-Carene	5.532	$C_{10}H_{16}$	0.60
12	2-Methylbutyl 2-methylbutanoate	5.694	$C_{10}H_{20}O_2$	0.90
13	2,6-Dimethyl-2,4,6-octatriene	6.077	$C_{10}H_{16}$	0.18
14	2-Propenamide	6.341	C_5H_9NO	0.01
15	Camphor	6.402	$C_{10}H_{16}O$	0.09
16	2-Furancarboxylic acid, cyclobutyl ester	6.707	$C_9H_{10}O_3$	0.21
17	Terpene-4-ol	6.859	$C_{10}H_{18}O$	0.49
18	alpha.-Terpineol	7.045	$C_{10}H_{18}O$	0.26
19	gamma.-Elemene	9.169	$C_{15}H_{24}$	1.63
20	alpha.-Cubebene	9.738	$C_{15}H_{24}$	0.44
21	Allo-Aromadendrene	9.936	$C_{15}H_{24}$	1.45
22	beta.-Caryophyllene	10.414	$C_{15}H_{24}$	6.95
23	gamma.-Muurolene	10.526	$C_{15}H_{24}$	1.62
24	alpha.-Caryophyllene	10.938	$C_{15}H_{24}$	5.81
25	Germacrene D	11.249	$C_{15}H_{24}$	0.34
26	Germacrene D	11.377	$C_{15}H_{24}$	2.13
27	alpha.-Guaiene	11.483	$C_{15}H_{24}$	0.40
28	Germacrene B	11.652	$C_{15}H_{24}$	3.89
29	Davana ether	11.752	$C_{15}H_{22}O_2$	
30	Selina-6-en-4-ol	11.986	$C_{15}H_{26}O$	1.34
31	delta.-Cadinene	12.084	$C_{15}H_{24}$	0.67
32	Davanone	12.627	$C_{15}H_{24}O_2$	2.61
33	trans-Nerolidol	12.721	$C_{15}H_{26}O$	7.17
34	3-Butyl-3-Methylcyclohexanone	12.856	$C_{11}H_{20}O$	1.31
35	Germacrene D-4-ol	13.047	$C_{15}H_{26}O$	0.95
36	beta.-Farnesene	13.100	$C_{15}H_{24}$	2.31
37	Caryophyllene oxide	13.195	$C_{15}H_{24}O$	2.99
38	Lanceol, cis	13.426	$C_{15}H_{24}O$	0.58
39	Pregan-20-one, 2-hydroxy-5, 6-epoxy-15-methyl-	13.544	$C_{22}H_{34}O_3$	3.54
40	3,7,11,15-Tetramethyl-2,6,10,14 hexadecatetraenyl acetate	13.877	$C_{22}H_{36}O_2$	5.82
41	tau.-Cadinol	13.966	C15H26O	2.40
42	Spathulenol	14.139	$C_{15}H_{24}O$	3.42
43	Steviol	14.369	$C_{20}H_{30}O_3$	0.38
44	Alloaromadendrene oxide	14.425	$C_{15}H_{24}$	2.38
45	Humulene	14.814	$C_{15}H_{24}$	0.82
46	n-Hexadecanoic acid	17.140	$C_{16}H_{32}O_2$	0.83
47	Phytol	18.343	$C_{20}H_{40}O$	0.94
48	6-Octadecenoic acid	18.523	$C_{18}H_{34}O_2$	2.69
49	Octadecanoic acid	18.663	$C_{18}H_{34}O_2$	0.57

Key: RT= Retention time; MF= Molecular formula

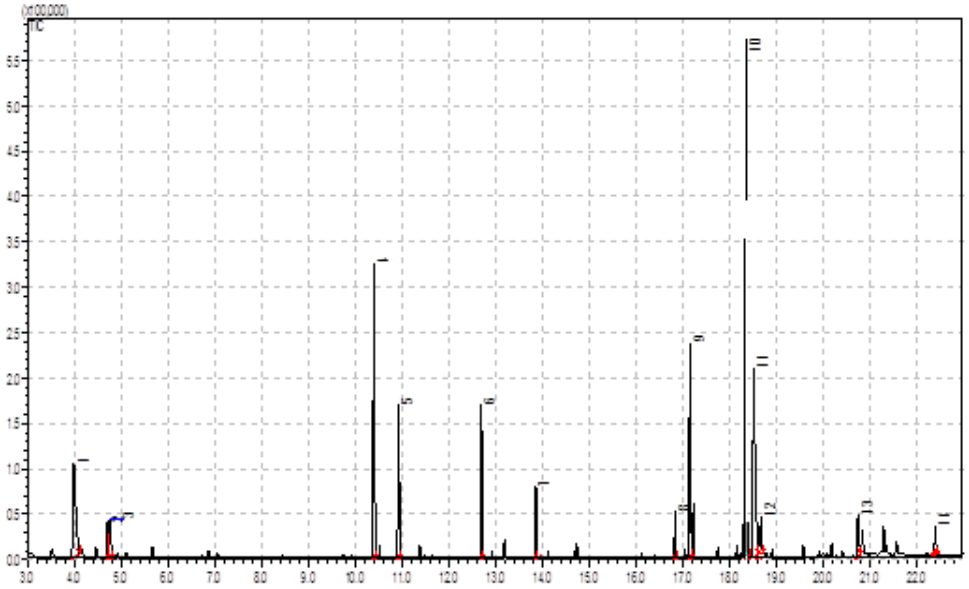

Figure 3. GCMS Chromatogram of fruit essential oil of *Lantana camara*.

Table 4: Chromatographic profile of the essential oil of the fruits of *Lantana camara*.

S/N	Name of compound	RT	MF	% Composition
1	Sabinene	3.983	$C_{10}H_{16}$	9.66
2	Limonene	4.700	$C_{10}H_{16}$	2.09
3	Eucalyptol	4.748	$C_{10}H_{18}O$	2.52
4	beta.-Caryophyllene	10.395	$C_{15}H_{24}$	13.57
5	alpha.-Caryophyllene	10.923	$C_{15}H_{24}$	6.97
6	trans-Nerolidol	12.689	$C_{15}H_{26}O$	6.93
7	alpha.-Linalool	13.855	$C_{10}H_{18}O$	2.92
8	2-Isopropyl-5-methyl-1-heptanol	16.826	$C_{11}H_{24}O$	1.64
9	n-Hexadecanoic acid	17.148	$C_{16}H_{32}O_2$	9.51
10	Phytol	18.346	$C_{20}H_{40}O$	23.04
11	Octadec-9-enoic acid	18.518	$C_{18}H_{34}O_2$	15.50
12	Pentadecanoic acid	18.661	$C_{15}H_{30}O_2$	1.95
13	9-Eicosyne	20.739	$C_{20}H_{38}$	2.61
14	Heptacosane	22.391	$C_{27}H_{56}$	1.09

Key: RT= Retention time; MF= Molecular formula

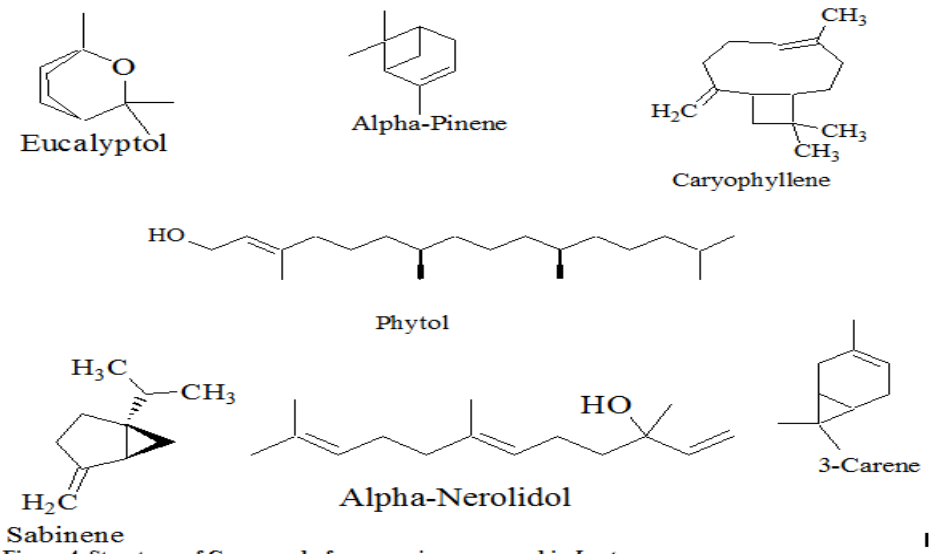

Figure 4. Structure of Compound of some major compound in *Lantana camara*.

DISCUSSION AND CONCLUSION

DISCUSSION

Chemo-microscopic analysis of *Lantana camara* revealed the presence of lignin, starch, cellulose, oxalate crystals, tannin, oils, proteins and absence of mucilage in the leaves while the flowers showed the presence of all tests except mucilage and lignin. The chemo-microscopic characters can be used for identification and quality control of the crude drug. The Chromatographic profile of the essential oils from the parts studied revealed: The components with the highest percentage compositions in the leaves were: gamma-terpinene (10.24%), eucalyptol (9.36%), alpha-pinene (5.82), beta-caryophyllene (5.13%). Kasali *et al.,* 2004 reported that the major components in *L. camara* leaves in Nigeria were: sabinene (19.6%), 1,8-cineole which is also known as eucalyptol (14.8%), beta-caryophyllene (12.7%), alpha-humulene also known as alpha-caryophyllene (6.3%). Eucalyptol, beta-caryophyllene and alpha-caryophyllene are common to both studies. The flower oil eucalyptol (7.65%), trans-nerolidol (7.17%), beta-caryophyllene (6.95%), sabinene (6.29%), 14-hexadecatetraenyl acetate (5.82%) and alpha-caryophyllene (5.81%) as the predominant constituents; while Kasali *et al.,* 2004 reported sabinene (21.5%), 1,8-cineole (12.6%), beta-caryophyllene (13.4%), alpha-humulene (5.8%) as the predominant constituents of the flower oil. The components present in the flowers in the present study are similar with that of Kasali *et al* except for the variation in percentage composition. There was the presence of 14-hexadecatetraenyl acetate which was absent in Kasali's work. The fruit oil had the following major component: phytol (23.04%), octadec-9-enoic acid (15.50%), beta-caryophyllene (13.57%), sabinene (9.66%), n-hexadecanoic acid (9.51%), alpha-caryophyllene (6.97%) and trans-nerolidol (6.93%). Usman *et al.,* 2012, reported that beta-caryophyllene (25.5-32.6%) and alpha-humulene (12.4-13.3%) were the major constituents in the fruit oil of *L. camara.* This is in correlation with the present study except for the variation in percentage composition.

The following major components were common in the leaves, flowers and fruits: eucalyptol, beta-caryophyllene and alpha-caryophyllene; while phytol (23.04%), octadec-9-enoic acid or oleic acid (15.50%), and n-hexadecanoic acid (9.51%) were present in the fruit oil only.

Eucalyptol is used in flavorings, fragrances, cosmetics and as a cough suppressant. Beta-caryophyllene is used for food flavoring. Alpha-caryophyllene has anti-inflammatory properties and it is a very effective analgesic when taken topically, orally or by aerosol. Trans-nerolidol is used as a flavoring agent, in perfumery and also used in non-cosmetic products like detergents and cleansers. n-Hexadecanoic acid also known as palmitic acid is used to produce soaps, cosmetics and industrial mold release agents. Phytol is used as a precursor for the manufacture of synthetic forms of Vitamin E and Vitamin K1, commercially it is used in fragrance industry, in cosmetics, shampoos, toilet soaps, household cleaners and detergents. Gamma-terpinene has perfume and flavoring properties but is mainly used to confer pleasant odour to industrial fluids. Octadec-9-enoic acid or oleic acid as its sodium salt is a major component of soap as an emulsifying agent. Oleic acid is used as an emollient. Small amounts of oleic acid are used as a emulsifying or solubilizing agent in aerosol products. It is also used to induce lung damage in certain type of animals like sheep for the purpose of testing new drugs and other means to treat lung disease. Alpha-pinene is used in insecticides because it is highly repellant to insects and it is also used in production of perfume and deodorants. Sabinene is used as anti-inflammatory, anti-bacterial and anti-fungal agent. 14-hexadecatetraenyl acetate is used in preparation of coenzymes, vitamin K and polyprenylquinones.

CONCLUSSION

In conclusion, the volatile oil components found in the different parts of *L. camara* based on the GCMS analysis find applications in flavorings, fragrances or perfumery, cough suppressant, manufacture of cosmetic products, manufacture of Detergents, soaps, emulsifying agent, manufacture of synthetic Vitamin E and Vitamin K1 as well as anti-inflammatory, anti-bacterial and anti-fungal agents and manufacture of aerosol product and insecticides.

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