

Asian Plant Research Journal

Volume 11, Issue 2, Page 10-23, 2023; Article no.APRJ.97088 ISSN: 2581-9992

Leaf Epidermal Microscopy, Chemo-Microscopy and GC-MS Analyses of Three *Ocimum* Species from Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/APRJ/2023/v11i2206

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/97088

> Received: 02/02/2023 Accepted: 04/03/2023 Published: 08/04/2023

Original Research Article

ABSTRACT

Comparative analyses of the leaf epidermal microscopy, chemo-microscopy and GCMS analysis of essential oils from three *Ocimum* species were analyzed. *Ocimum* belong to the family Lamiaceae. Leaf epidermal microscopy revealed anomocytic stomata in the species studied. *Ocimum basilicum* has anomocytic stomata on both surfaces but were more abundant on the lower surface; cell walls were wavy on the upper surface and had glandular trichomes on both surfaces. *Ocimum canum* had anomocytic stomata on both surfaces; cell walls were wavy and trichomes were glandular and non-glandular occurring on both surfaces but occurring more on the upper surface. The non-glandular trichomes are cone-shaped with pointed tip. *Ocimum gratissimum* has anomacytic

Asian Plant Res. J., vol. 11, no. 2, pp. 10-23, 2023

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stomata on both surfaces occurring more on the lower surface; the cell walls are curved on both surfaces and glandular trichomes occur on both surfaces which are more abundant on the lower surface. The glandular trichomes are radially flagellated in all the species studied. Lignin, tannins, cellulose, mucilage, starch, calcium oxalate, oils and proteins were observed in all species studied. The GC-MS analyses of the leaf essential oils revealed 35 compounds for *O. basilicum*, 49 compounds for *O. canum* and 34 compounds for *O. gratissimum* with 3-allyl-6-methoxyphenol being the most abundant in *O. basilicum* (34.42%); 1-Cyclopentene-1-methanol,2-methyl-5-1-methyl, the most abundant in *O. canum* (29.56%) and thymol being the most abundant in *O. gratissimum* (48.04%). The leaf epidermal microscopy and the chemo-microscopy can be used for the standardization of the plant. Chemical composition of the three *Ocimum* species can be used for the treatment of several diseases.

Keywords: Ocimum species; microscopy; analysis; Nigeria.

1. INTRODUCTION

"The Genus Ocimum comprised of about 200 species distributed over Asia. Africa. Central and Southern America" [1,2]. "Ocimum is cultivated essential for its oil with many potent pharmacological application and culinarv. perfume for herbal toiletries, aromatherapy treatment and as flavoring agent" [3]. The study was done to compare the leaf epidermal microscopy, chemo-microscopy, and GC-MS analyses of Ocimum basilicum L. Ocimum canum Sims; and Ocimum gratissimum L. leaves.

Ocimum basilicum is the most popular species and is assumed to originate from India, Africa, and/or the Middle East [4]. It is the most common basil type in the Western hemisphere and has the greatest economic importance. It is utilized as a food ingredient, remedy, cosmetic ingredient, and for ornamental purpose [5].

Ocimum canum is used in Africa to treat malaria, and headache, and has been used as an analgesic and rubefacient [6,7]. It also has been used to manage diabetes mellitus in Ghana [7]. Ethnopharmacology studies document its use in treating dysuria in Iran [8]. The essential oils of the plant species have been used mainly for antipyretic purposes and for treating respiratory diseases on the eastern coast of Africa [9,6]. "Ocimum canum is an underutilized medicinal plant that is used for the treatment of gastrointestinal problems and also for the preparation of local soups" [10]. "The leaves have high carbohydrate content, ash, crude fat and crude fiber, but very low in protein and high concentration of calcium with appreciable levels of potassium, sodium, phosphorous magnesium" and [10]. "The plant was found to be a good source of iron, zinc and manganese. Furthermore, the concentrations of cadmium and lead, which are toxic metals were very low, while the vitamin C content of the leaves was found to be high" [10].

"Ocimum gratissimum is indigenous to tropical areas especially India and it is also in West Africa" [11]. "In Nigeria, it is found in the Savannah and coastal areas [11]. It is cultivated in Ceylon, South Sea Islands, and also within Nepal, Bengal, Chittagong and Deccan" [12]. "It is known by various names in different parts of the world. In India it is known by its several vernacular names, the most commonly used ones being Vriddhutulsi (Sanskrit), Ram tulsi (Hindi), Nimma tulasi (Kannada)" [12]. "In the southern part of Nigeria, the plant is called "effinrin-nla" by the Yoruba speaking tribe" [13]. "It is called "Ahuji" by the Igbos, while in the Northern part of Nigeria; the Hausas call it "Daidooya". Ocimum gratissimum is grown for the essential oils in its leaves and stems. Eugenol, thymol, citral, geraniol and linalool have been extracted from the oil" [14]. "Essential oils from the plant have been reported to possess an interesting spectrum of antifungal properties. The anti-nociceptive property of the essential oil of the plant has been reported" [15]. "The whole plant and the essential oil are used in traditional medicine especially in Africa and India. The essential oil is also an important insect repellent" [15]. "Eugenol and thymol extracted from the leaf are substitutes for clove oil and thyme oil" [15]. "The essential oil is also used in perfumery" [15]. "This species is often planted as ornamental, culinary and medicinal plant. In Asia, a tea is made from the leaves" [16]. "Leaves are also eaten in salads and used as a condiment for sauces, soups or meat" [16]. "It is also planted for hedges and as a mosquito repellent" [17,18].

2. MATERIALS AND METHODS

2.1 Plant Material

Ocimum canum and *Ocimum grattissimum* were purchased while *Ocimum basilicum* was collected from a garden.

2.2 Leaf Epidermal Microscopy

The methods of Ayodele and Olowokudejo [19] were adopted for the leaf epidermal microscopy. Slides were labeled appropriately and examined under the light microscope (ACCU-SCOPE 3025 Microscope Series) while photographs of the micro morphological features were taken using the camera (Industrial Design Camera E31SPM12000KPA) with magnifications x100 and x400. Terminologies are based on Metcalfe and Chalk [20].

2.3 Chemo-Microscopy

The collected leaves were air dried and finely crushed into powder with a mortar and a pestle. A microscope slide was prepared by sprinkling the finely crushed particle on different slides and reagent. Phloroglucinol, conc. Hydrochloric acid, 66% sulphuric acid N/50 Iodine, 1% picric acid, millions reagent and Sudan IV reagent was used for the test [21].

2.4 GC-MS Analysis

2.4.1 Essential oil extraction

The Methods of Okhale *et al.*, 2018 were used for the extraction of the oils. The oils were sent in vials to Schimadzu Training Center for analytical Institute (STC), Lagos for analysis.

2.4.2 Gas chromatography–Mass spectrometry (GC- MS) analysis

The methods of Okhale *et al.*, 2018 were used where freshly collected leaves of *O. canum*, *O. gratissimum*, and *O. basilicum* samples were chopped separately into pieces and each 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 using

Shimadzu QP-2010 GC with QP-2010 mass selective detector IMSD, operated in the EI mode (electron energy =70Ev), scan range = 45400 amu, and scan rate = 3.99 scan/sec], and Shimadzu GCMS solution data system. The GC column was HP-5MS fused silica capillary with a 5% phenylpolymethyllsililoxane stationary phase, length 30 m, internal diameter 0.25 mm and film thickness 0.25 µm. The program used for GC oven temperature was isothermal at 60oC, increased from 60oC to 180oC at rate of 10oC/min. held at 180oC for 2 minutes: increased from 180oC at a rate of 15oC/min, then held at 280oC for 4 minutes. The injection port temperature was 250oC. The ionization of sample components was performed in the electron impact mode (70eV). Injector temperature was 250oC. The injection port 250°C temperature was while detector temperature was 280°C. Diluted sample (1/100 in hexane. v/v) of 1.0 µL was injected using auto sampler and in the split mode with ratio of 20:80. Individual constituents were identified bv comparing their mass spectra with known compounds and NIST Mass Spectral Library (NIST 11). The percentages of each component were reported as raw percentages based on the total ion current without standard.

3. RESULTS

3.1 Leaf Epidermal Microscopy

species of Ocimum revealed The three Anomocytic stomata. Ocimum basilicum has anomocytic stomata on both surfaces and more aboundant on the lower surface; cell walls are wavy on the upper surface and have glandular trichomes on both surfaces. Ocimum canum also has anomocytic stomata on both surfaces; cell walls are wavy and trichomes are glandular and non-glandular occurring on both surfaces but more on the upper surface. The non-glandular trichomes are cone-shaped with pointed tips. Ocimum gratissimum has anomacytic stomata on both surfaces but occurring more on the lower surface; the cell walls are curved on both surfaces and glandular trichomes occur on both surfaces but more abundant on the lower The glandular surface. trichomes are radially flagellated in all the species studied (Figs. 1, 2 & 3).

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Fig. 1. Leaf epidermal microscopy of Ocimum basilicum

A) Lower surface X 100. Anomocytic stomata, wavy cell walls and glandular capitate trichome
 B) Lower surface X 400. Anomocytic stomata and multicellular glandular capitate trichome

- C) Upper surface X 100. Multicellular Glandular capitate trichomes and no stomata.
- D) Upper surface X400. Wavy cell shape and glandular trichome



Fig. 2. Leaf epidermal microscopy of three Ocimum canum

- A) Lower surface X 100. Anomocytic stomata, wavy cell wall, glandular and non-glandular trichomes
- B) Lower surface X 400. Ancmostic stomata, wavy cell shape and non-glandular cone-shaped trichome
- Upper surface X 100. Flagellated glandular and non-glandular cone-shaped trichomes; wavy cell shape C)
- D) Upper surface X 400. Glandular and non-glandular cone-shaped trichomes.

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Fig. 3. Leaf epidermal microscopy of Ocimum gratissimum

A) Lower surface x100. Anomocytic stomata, Flagellated glandular trichomes and wavy cell wall

B) Lower surface x400. Anomocytic stomata, Flagellated glandular trichomes and wavy cell wall

C) Upper surface x100. Anomocytic stomata, Flagellated glandular trichomes and wavy cell wall
 D) Upper surface x400. Anomocytic stomata, Flagellated glandular trichomes and wavy cell wall.

3.2 Chemo-microscopy

The chemo-microscopic analyses were positive for Lignin, Cellulose, Tannins, Mucilage, Starch, Calcium oxalate, oils and Protein in all the species studied (Table 1).

Table 1. Chemo-microscopy of three Ocimum
species

Test	Ocimum basilicum	Ocimum canum	Ocimum gratissimum
Lignin	+	+	+
Cellulose	+	+	+
Tannins	+	+	+
Mucilage	+	+	+
Starch	+	+	+
Calcium	+	+	+
OXALATE			
Oil	+	+	+
Protein	+	+	+

3.3 GC-MS Analysis

The GC-MS analyses of the three species studies revealed 35 compounds for *O. basilicum*, 49 compounds for *O. canum* and 34 compounds for *O. gratissimum* with 3-Allyl-6-methoxyphenol being the most abundant in *O. basilicum*

(34.42%); 1-Cyclopentene-1-methanol,2-methyl-5-1-methyl, the most abundant in *O. canum* (29.56%) and Thymol being the most abundant in *O. gratissimum* (48.04%).

4. DISCUSSION

"All the species studied had anomocytic stomata in this type, the accessory or subsidiary cells are five in number. Stomata are used for the exchange of gases in between the plant and atmosphere" [22]. "To facilitate this function, each stoma opens in a sub-stomatal chamber or respiratory cavity. Evaporation of water also takes place through the stomata" [23].

Stomata are minute pores on the surface of green plants that are involved in the exchange of water and carbon dioxide between the plants and its atmosphere. It can be easily seen under a microscope. "A single pore is called the stoma, which is found in the epidermis of leaves, stems, and other organs of the plant. Thousands of stomata are there on the surface of the leaves. Stomata help in the process of transpiration and photosynthesis which are the most essential process for the survival of a plant" [24]. These processes are carried out through well-defined structures and procedures.

S/N	Names of compound	Retention Time	% Composition
1.	1,8-Cineole	6.724	2.37
2.	1,3,6-Octatriene, 3,7-dimethyl-, (Z)-	6.992	0.81
3.	p-Mentha-1,5-diene Menthadiene	7.133	0.26
4.	Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1-methy	7.198	0.39
5.	Bicyclo[2.2.1]heptan-2-one, 1,3,3-trimethyl-	7.373	0.68
6.	1,5-Dimethyl-1-vinyl-4-hexenyl butyrate	7.621	20.88
7.	Ethyl (2E)-2-(1,7,7-trimethylbicyclo[2.2.1]hept-2- ylidene)hydrazinecarboxylate	8.056	1.57
8.	endo-Borneol	8.410	0.60
9.	Terpinen-4-ol	8.560	4.15
10.	alphaTerpineol	8.734	0.69
11.	Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, acet	9.067	0.09
12.	Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, ace	9.781	0.63
13.	3-Allyl-6-methoxyphenol	10.514	34.42
14.	alfaCopaene	10.942	0.08
15.	Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-meth	11.059	2.44
16.	1H-Cyclopenta [1,3]cyclopropa[1,2]benzene, oct	11.117	0.46
17.	Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-methyl-3- pentenyl)-	11.280	1.03
18.	Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trimethyl-4- vinyl-	11.388	1.55
19.	Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-methyl-3- pentenyl)-	11.510	10.25
20.	gammaMuurolene	11.626	0.63
21.	Humulene	11.722	0.77
22.	(+)-epi-Bicyclosesquiphellandrene	11.792	0.61
23.	betacopaene	11.968	2.63
24.	Bicyclo[5.3.0]decane, 2-methylene-5-(1-methylvinyl)-8- methyl-	12.035	0.21
25.	Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trimeth	12.114	0.53
26.	Azulene, 1,2,3,4,5,6,7,8-octahydro-1,4-dimethyl-7-(1- methylethenyl)-, (1S,4S,7R)-	12.186	0.87
27.	Naphthalene, 1,2,3,4,4a,5,6,8a-octahydro-7-methyl-4- methylene-1-(1-methylethyl)-, (1α,4aβ,8aα)-	12.253	1.66
28.	1H-3a,7-Methanoazulene, octahydro-3,8,8-trimethyl-6- methylene-, [3R-(3α,3aβ,7β,8aα)]-	12.318	0.90
29.	Cubedol	12.425	0.12
30.	Cyclohexanemethanol, 4-ethenyl-α,α,4-trimethyl-3-(1- methylethenyl)-, [1R-(1α,3α,4β)]-	12.531	0.83
31.	1H-Cycloprop[e]azulen-7-ol, decahydro-1,1,7- trimethyl-4-methylene-, [1ar-(1aα,4aα,7β,7aβ,7bα)]-	12.834	0.26
32.	Caryophyllene oxide	12.892	0.08
33.	Cubedol	13.175	0.60
34.	Bicyclo[4.4.0]dec-1-ene, 2-isopropyl-5-methyl-9- methylene-	13.373	5.17
35.	1H-Cycloprop[e]azulen-4-ol, decahydro-1,1,4,7- tetramethyl-, [1aR (1aα,4β,4aβ,7α,7aβ,7bα)]-	13.501	0.74

Table 2. Chromatographic profile of Ocimum basilicum leaf oil

Table 3	Chromatogra	nhic profile	of Ocimum	<i>canum</i> leaf oil
Table J.	omonatogra	ipine prome		canam lear on

1. alphaPinene 5.533 3.89 2. 2.2-dimethyl-3methyliclenebicyclo[2.2.1]heptane 5.710 0.40 3. Bicyclo[3.1.0]hex-2-ene, 4-methyl-1-(1- 6.010 0.15 methylethyl)- C.yclohexene, 4-methylene-1-(1-methylethyl)- 6.068 0.09 5. Bicyclo[3.1.1]heptane, 6.6-dimethyl-2- 6.211 2.23 methylene-, (15)- 6.423 0.07 1.3-Exyclohexacine, 2-methyl-5-(1-methylethyl)- 6.626 8.69 9. Cyclohexene, 4-methyl-5-(1-methylethyl)- 7.61 1.8 Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.198 7.61 1.1 Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.503 0.72 1.3 Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.651 7.53 1.4 1-Octen-3-yl-acetate 7.503 0.72 1.5 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 1.6 Bicyclo[2.2.1]heptan-2-on, 1,7.7-trimethyl- 8.55 0.18 1.4 1-Octen-3-yl-acetate 8.608 29.56 2.3-	S/N	Names of compound	Retention Time	% Composition
2. 2.2-dimethyl-3methylidenebicyclo[2.2.1]heptane 5.710 0.40 3. Bicyclo[31.0]hex2-ene, 4-methyle1.(1- methylethyl)- 6.010 0.15 4. Cyclohexane, 4-methylene1.(1-methylethyl)- 6.068 0.09 5. Bicyclo[3.1.1]heptane, 6,6-dimethyl-2- 6.211 2.23 methylene, (15)- 6.423 0.07 (+)-4-Carene 6.626 8.69 9. Cyclohexane, 1-methyl-5(1-methylethyl)- 6.562 0.56 1. Bicyclo[3.1.0]hexan-2-0.1, 2-methyl-5.(1- 7.107 3.79 1. Bicyclo[3.1.0]hexan-2-0.1, 2-methyl-5.(1- 7.581 7.89 1. Bicyclo[3.1.0]hexan-2-0.1, 2-methyl-5.(1- 7.581 7.89 1. Bicyclo[3.1.0]hexan-2-0.2, 2-methyl-5.(1- 7.581 7.89 1. Dicyclo[3.1.0]hexan-2-0.2, 2-methyl-5.(1- 7.581 7.89 1. Bicyclo[2.2.1]heptan-2-0.1, 7.7 trimethyl- 8.505 1.13 1. T.Cyclohexen-1-0.1, 1-methyl-4.(1-methylethyl)- 7.864 0.76 1. Cyclohexen-1-0.1, 1.7.7 trimethyl- 8.455 0.	1.	alphaPinene	5.533	3.89
3. Bicyclo[3.10]hex-2-ene, 4-methyl-1-(1- methylethyl)- 6.010 0.15 4. Cyclohexene, 4-methylene, 1-(1-methylethyl)- 6.068 0.09 5. Bicyclo[3.11]heptane, 6.6-dimethyl-2- 6.211 2.23 6. p-Mentha-1,5-diene Menthadiene 6.423 0.07 7. (+)-4-Carene 6.626 8.69 8. 1-Methyl-4-(propan-2-ylbenzene 6.626 8.69 9. Cyclohexene, 1-methyl-5-(1-methylethyl)-, (17, 379 711 Bicyclo[3.10]hexan-2-0, 2-methyl-5-(1- 7.198 7.61 7. methyl-4-(propan-2-ylbenzene 7.503 0.72 7.89 10. garma_Terpinene 7.503 0.72 7.89 11. Bicyclo[2,1]heptan-2-one, 1.7.7-trimethyl- 7.65 1.53 7.61 12. Cyclohexen-1-0, 1-methyl-4-(1-methylethyl) 7.89 0.76 13. Bicyclo[2,2.1]heptan-2-one, 1.7.7-trimethyl- 8.55 0.18 14. 1-Octen-3-yl-acetate 7.733 0.87 15. 2-Cyclohexen-1-0, 1-methyl-4-(1-methylethyl)- 8.455 <t< td=""><td>2.</td><td>2.2-dimethyl-3methylidenebicyclo[2.2.1]heptane</td><td>5.710</td><td>0.40</td></t<>	2.	2.2-dimethyl-3methylidenebicyclo[2.2.1]heptane	5.710	0.40
methylethyl, Intervention 4. Cyclohexene, 4-methylene, 1-(1-methylethyl)- 6.068 0.09 5. Bicyclo[3,1.1]heptane, 6.6-dimethyl-2- 6.211 2.23 methylene, (15)- 6.423 0.07 (+)-4-Carrene 6.423 0.07 (+)-4-Carrene 6.626 8.69 Cyclohexene, 1-methyl-5-(1-methylethyl)- 7.107 3.79 11. Bicyclo[3,1.0]hexan-2-ol, 2-methyl-5-(1- 7.198 7.61 methylethyl)-, (1a,2B,5a)- 7.65 1.53 12. (+)-4-Carrene 7.605 1.53 13. 10.0pexan-2-ol, 2-methyl-5-(1- 7.198 7.61 methylethyl)-, (1a,2B,5a)- 7.65 1.53 14. 1-Octon-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-ol, 1,7-trimethyl- 1.8 8.608 29.56 20. 3-Cyclohexene-1-methanol, 2-methyl-5-(1-met 8.608 29.56 21. 1.4-Cyclopaentene-1-methanol, 2-meth	3.	Bicvclo[3.1.0]hex-2-ene. 4-methyl-1-(1-	6.010	0.15
4. Cyclohexene, 4-methylene-1-(1-methylethyl)- 6.068 0.09 5. Bicyclo[3.1.1]heptane, 6,6-dimethyl-2- 6.211 2.23 methylene-, (15)- 6.211 2.23 6. p-Mentha-1,5-diene Menthadiene 6.423 0.07 1.3-Cyclohexadiene, 2-methyl-5-(1-methylethyl)- 6.822 0.56 8. 1-Methyl-4-(propan-2-yl)benzene 6.626 8.69 9. Cyclohexene, 1-methyl-5-(1-methylethyl)-, (17, 3,79 7.61 11. Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.53 0.72 13. Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.581 7.89 methylethyl)-, (13, 28,5a)- 7.665 1.53 14. 1-Octen-3yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 16. Bicyclo[2.2.1]heptan-2-ol, 1.7.7-trimethyl-, (1S- 8.455 0.18 9. 1-Cyclohexen-1-methanol, 2-methyl-6-(1-met 8.608 29.56 13. 1.4-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl- 8.73 0.87 14. </td <td>0.</td> <td>methylethyl)-</td> <td>0.010</td> <td></td>	0.	methylethyl)-	0.010	
5. Bícyclo[3.1,1]heptané 6.6-dimethyl-2- 6.211 2.23 6. p-Mentha-1.5-diene Menthadiene 6.423 0.07 (1)-4-Carene 6.582 0.56 8. 1-Methyl-4-(propan-2-yl)benzene 6.626 8.69 9. Cyclohexne,1-methyl-5-(1-methyleftenyl)-, (R) 6.744 3.90 9. Gyclo[3.1,0]hexan-2-0, 2-methyl-5-(1- 7.198 7.61 9. methylethyl)-, (1α,2β,5α)- 7.503 0.72 12. (+)-4-Carene 7.665 1.53 14. 1-Octen-3-yl-accetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-ol, 1.7.7-trimethyl- 8.050 1.13 (1) Cyclohexene-1-nethanol, 2-methyl-5-(1-met 8.608 29.56 20. Sicyclo[2.2.1]heptan-2-ol, 1.7.7-trimethyl-, (1-met 8.608 29.56 21. 1.4-Cyclohexene-1-methanol, 4-(1-methylethyl) 8.73 0.87 21. 1.4-Cyclohexene-1-methanol, 4-(1-methylethyl) 8.608 29.56	4.	Cvclohexene. 4-methylene-1-(1-methylethyl)-	6.068	0.09
methylene, (1S). Litt Control Litt 6. p-Mentha-1,5-diene Menthadiene 6.423 0.07 1.3-Cyclohexadlene, 2-methyl-5-(1-methylethyl). 6.582 0.56 1. Methyl-4-(propan-2-yl)benzene 6.582 0.56 9. Cyclohexane, 1-methyl-5-(1-methylethyl). 7.107 3.79 11. Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.198 7.61 methylethyl). (1α,2β,50) 7.503 0.72 13. Bicyclo[2.1.0]hexan-2-ol, 2-methyl-5-(1- 7.581 7.89 14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl). 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7.7-trimethyl-, 8.050 1.13 (1R). 2-Cyclohexan-1-ol, 1-methyl-4-(1-methylethyl) 8.455 0.18 endo)- 1.4-Cyclohexane-1-ol, 1-methyl-4-(1-methylethyl) 8.050 1.13 (1R). 2-Cyclohexane-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7.7-trimethyl-, 15-845 0.18 end	5.	Bicyclo[3,1,1]heptane, 6,6-dimethyl-2-	6.211	2.23
6. priMentha-1,5-diene Menthadiene 6.423 0.07 (f) 4-Carene 6.582 0.56 8. 1-Methyl-4-(propan-2-yll)benzene 6.626 8.69 9. Cyclohexne,1-methyl-5-(1-methylethyl)-, (R) 6.744 3.90 10. gamma-Terpinene 7.107 3.79 11. Bicyclo[3.1.0]hexan-2-0, 2-methyl-5-(1- 7.503 0.72 12. (+)-4-Carene 7.601 7.89 13. Bicyclo[3.1.0]hexan-2-0, 2-methyl-5-(1- 7.503 0.72 14. 1-Octen-3-yl-acelate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, 8.050 1.13 (fR)- 1.0 1.7 1.2 17. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-0, 1,3,3-trimethyl-, 18.8 8.608 29.56 13. 1-Cyclohexanel-n-methanol, 4.(1- 8.731 0.87 14. Cyclohexanel-n-methanol, 4.(1- 8.731 0.22 15. 3.5(cyclop2.2.1]hept	0.	methylene- (1S)-	0.2.1	
1.3-Cyclohexadiene, 2-methyl-5-(1-methylethyl)- 0.125 0.13 7. (+)-4-Carene 6.582 0.56 8. 1-Methyl-4-(propan-2-yl)benzene 6.526 8.69 9. Cyclohexane, 1-methyl-5-(1-methylethenyl)-, (R) 6.744 3.90 10. garmaTerpinene 7.107 3.79 11. Bicyclo[3.1.0]hexan-2-0, 2-methyl-5-(1- 7.198 7.61 12. (+)-4-Carene 7.503 0.72 13. Bicyclo[3.1.0]hexan-2-0, 2-methyl-5-(1- 7.581 7.89 14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-0, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7.7-trimethyl-, 8.050 1.13 17. 2-Cyclohexan-1-ol, 1-methyl-4-(1-methylethyl) 8.455 0.18 9. 1-Cyclopentene-1-methanol, 2-methyl-5-(1-met 8.068 29.56 13. -Cyclohexane-1-ol, 1.7.7-trimethyl- 8.733 0.87 21. 1-Cyclohexane-1-methanol, 2-methyl-5-(1-met 8.068 29.56 <t< td=""><td>6</td><td>n-Mentha-1 5-diene Menthadiene</td><td>6 4 2 3</td><td>0.07</td></t<>	6	n-Mentha-1 5-diene Menthadiene	6 4 2 3	0.07
1.9 1.9 1.9 1.9 1.9 2. 1.9 1.9 1.9 1.9 1.9 3. 1.9 1.0 1.	0.	1 3-Cycloberadiene 2-methyl-5-(1-methylethyl)-	0.420	0.07
1. (+)++Oatele 0.522 0.50 2. 1. 0.526 8.69 9. Cyclohexene, 1-methyl-5-(1-methylethenyl)-, (R) 6.744 3.90 10. garmaTerpinene 7.107 3.79 11. Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.198 7.61 12. (+)-4-Carene 7.503 0.72 13. Bicyclo[2.1.0]hexan-2-ol, 2-methyl-5-(1- 7.581 7.89 methylethyl)-, (1a, 2a, 5a)- 7.665 1.53 14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-0, 1-methyl-4-(1-methylethyl) 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-on, 1,7,7-trimethyl-, (1S- 8.455 0.18 endo)- 1.4-Cyclohexaten-1-methanol, 2-methyl-5-(1-met 8.608 29.56 20. 3-Cyclohexene-1-methanol, 2-methyl-5-(1-met 8.608 29.56 21. 1.4-Cyclohexaten-1-methanol, 2-methyl-5-(1-met 8.608 29.56 22. 1.9 1.9 1.22 0.33 23. 1.4-dihydioxy-peneth-2-ene 9.418 0.73 24. 1	7	(+)-4-Carono	6 592	0.56
6. 10. 1	7. o	1 Mothyl 4 (propan 2 yl)bonzono	6.626	0.50 8 60
S. Cyclolitextente, Finiteurys-1(1-inteurytentienty), (N) 6.74-4 3.50 10. gamma. Terpinene 7.107 3.79 11. Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.188 7.61 12. (+)-4-Carene 7.503 0.72 13. Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.581 7.89 14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, 1(S- 8.455 0.18 endo)- (1R)- 7.2 Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, 1(S- 8.455 0.18 endo)- 1 4-Cyclohexanel-methanol, 4-(1- 8.791 1.22 19. 1-Cyclopentene-1-methanol, 4-(1- 8.791 1.22 methylethyl)- 2.8 Sicyclo[2.2.1]heptan-2-ol, 1, 3,3-trimethyl- 9.072 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 <t< td=""><td>0. 0</td><td>Cyclobovono 1 motbyl 5 (1 motbylothonyl) (D)</td><td>0.020</td><td>2.09</td></t<>	0. 0	Cyclobovono 1 motbyl 5 (1 motbylothonyl) (D)	0.020	2.09
10. gamma. Hephere 1.107 3.79 11. Bicyclo[3.10]hexan-2-0, 2-methyl-5-(1- 7.198 7.61 2. (+)-4-Carene 7.503 0.72 13. Bicyclo[3.10]hexan-2-ol, 2-methyl-5-(1- 7.581 7.89 methylethyl), (1a,2a,5a)- 7.665 1.53 2. Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1.7,7-trimethyl-, 8.050 1.13 (1R)- 1.7 2.2/cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1.7,7-trimethyl-, (1S- 8.608 29.56 0.3 Cyclohexene-1-methanol, q.4-trimethyl-, stass 0.87 14. 1-Cyclopentene-1-methanol, q.4-trimethyl-, stass 0.87 21. 1.4-Cyclohexadiene-1-methanol, q.4-trimethyl-, stass 0.86 23. 1.4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1.4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.1]heptan-2-ol, 1.7,7-trimethyl-, 9.783 0.91 acetate 26. 6.6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0	9.	Cyclonexene, 1-methyl-5-(1-methylethenyl)-, (K)	0.744	3.90
I1. Bicycloid, 1. Unexan-2-oi, 2-methyl-s-(1- 7.196 7.61 12. (+)-4-Carene 7.503 0.72 13. Bicycloid, 1.0]hexan-2-ol, 2-methyl-5-(1- 7.581 7.89 methylethyl), (1a, 2a, 5a)- 7.665 1.53 14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-oi, 1-methyl-4-(1-methylethyl)- 8.050 1.13 (1R)- 1.0 8.050 1.13 (1R)- 1.0 8.050 1.13 (1R)- 8.050 1.13 1.13 (1R)- 8.050 1.13 1.13 (1R)- 8.050 1.13 1.14 (1R)- 8.455 0.18 1.14 (-Cyclopexen-1-oi, 1-methyl-5-(1-met 8.608 29.56 2.3 2. 3-Cyclopexen-1-oi, 1-a, 3-trimethyl- 8.733 0.87 2. Bicycloid, 2.1]heptan-2-oi, 1, 3.3-trimethyl- 9.072 0.69 2. Bicycloid, 2.1]heptan-2-oi, 1, 7.7-trimethyl- 9.783 0.91 2.	10.	gammarepinene Disusla[2,4,0]havan 0 al 0 mathul 5 (4	7.107	3.79
Intertrytemyl)-, (14,25,30)- 12. (+)-4-Carene 7.503 0.72 13. Bicyclo[3.10]hexan-2-ol, 2-methyl-5-(1- 7.581 7.89 14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.1]heptan-2-one, 1,7,7-trimethyl-, 8.050 1.13 17. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, 1(S-ectoplacetate, 1/2, Cyclohexane-1-methanol, 2-methyl-5-(1-met 8.608 29.56 20. 3-Cyclohexene-1-methanol, 2,4-trimethyl- 8.733 0.87 21. 1,4-Cyclopentene-1-methanol, 4-(1- 8.791 1.22 methylethyl)- 2 Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, 9.072 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 acetate 0.941 0.16 26.	11.	Bicyclo[3.1.0]nexan-2-oi, 2-methyl-5-(1-	7.198	7.61
12. (+)-4-Caterie 7.503 0.72 13. Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1- 7.581 7.89 14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, 8.050 1.13 17. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, 1(S- 8.455 0.18 endo)- 1 1.4-Cyclopentene-1-methanol, 4.04-trimethyl- 8.733 0.87 19. 1-Cyclopentene-1-methanol, 4.04-trimethyl- 8.733 0.87 21. 1.4-Cyclohexenal-methanol, 4.04-trimethyl- 8.733 0.87 21. 1.4-Cyclohexenal-methanol, 4.04-trimethyl- 9.072 0.69 acetate 0.414 8.791 1.22 methylethyl)- 9.072 0.69 acetate 9.418 0.73 23. 1.4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 acetate	40	methylethyl)-, $(1\alpha, 2\beta, 5\alpha)$ -	7 500	0.70
13. Bicyclo[3.1.0]nexan-2-0, 2-methyl-5-(1- 7.881 7.89 14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, 18- 8.050 1.13 17. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (15- 8.455 0.18 endo)- - 8.068 29.56 19. 1-Cyclopentene-1-methanol, q.a4-trimethyl- 8.733 0.87 21. 1.4-Cyclohexadiene-1-methanol, 4.(1- 8.791 1.22 methylethyl)- 9.072 0.69 acetate 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, 9.783 0.91 acetate 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.1]heptan-2-0, 1,7,7-trimethyl-, 9.783 0.91 acetate 0.11 0.16 0.76 26. 6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl/jmethyl 10.186 <	12.		7.503	0.72
methylethyl), (1a,2a,5a)- 14. 1-Octen-3y-lacetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, 8.050 1.13 17. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (1S- 8.455 0.18 endo)- 1 1-Cyclopentene-1-methanol, 2-methyl-5-(1-met 8.608 29.56 20. 3-Cyclohexene-1-methanol, 4.(1- 8.791 1.22 methylethyl)- 0.72 0.69 21. 1,4-Cyclohexadiene-1-methanol, 4.(1- 8.791 1.22 methylethyl)- 0.72 0.69 0.69 22. Bicyclo[2.1]heptan-2-ol, 1,3,3-trimethyl-, 9.783 0.91 0.22 23. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 0.55 23. 1,4-dihydroxy-p-menth-2-ene 9.583 0.91 acetate 24. 1,4-dihydroxy-p-menth-2-ene 9.10 0.186 0.76 25. Bicyclo[2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 0.2	13.	Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1-	7.581	7.89
14. 1-Octen-3-yl-acetate 7.665 1.53 15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, 8.050 1.13 (1R)- 8.050 1.13 17. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (1S- 8.455 0.18 endo)- 1 6.008 29.56 20. 3-Cyclohexene-1-methanol, 2-methyl-5-(1-met 8.608 29.56 20. 3-Cyclohexadiene-1-methanol, 4-(1- 8.733 0.87 21. 1,4-Cyclohexadiene-1-methanol, 4-(1- 8.733 0.87 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, 9.072 0.69 acetate, (1R,2R,4S)- 20.11 1.22 23. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 acetate 0.16 0.76 26. 6.6-Dimethylbicyclo[3.1.1]hept-2-ene-2-yl)methyl 10.186 0.76 27. afa -Copaene 10.941 0.16		methylethyl)-, (1a,2a,5a)-		
15. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)- 7.894 0.76 16. Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, 8.050 1.13 17. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl) 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (1S- endo)- 8.455 0.18 19. 1-Cyclopentene-1-methanol, 2,-methyl-5-(1-met 8.608 29.56 20. 3-Cyclohexane1-methanol, 4,-(1- 8.733 0.87 21. 1,4-Cyclohexadiene-1-methanol, 4-(1- 8.791 1.22 methylethyl)- 20.86 0.69 0.69 acetate 11, 4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.418 0.76 25. Bicyclo[2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 acetate 0.91 0.186 0.76 26. 6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0.76 acetate 0.941 0.16 0.21 methylethenyl)-, [15-(1a,2b,4b)]- 11.058 0.21 methylethenyl-, 1-se, 2,6-dimethyl-6-(4- 11.283 0.11	14.	1-Octen-3-yl-acetate	7.665	1.53
16. Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-, (1R)- (1R)- (1R)- 8.050 1.13 17. 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (1S- endo)- 8.455 0.18 19. 1-Cyclopentene-1-methanol, $\alpha, \alpha 4$ -trimethyl- 8.733 0.87 21. 1.4-Cyclohexaciene-1-methanol, $\alpha, \alpha 4$ -trimethyl- 8.733 0.87 21. 1.4-Cyclohexaciene-1-methanol, $\alpha, \alpha 4$ -trimethyl- 8.733 0.87 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, 9.072 0.69 acetate, (1R,2R,4S)- 9.072 0.69 23. 1.4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1.4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 acetate 0.16 0.76 acetate 0.941 0.16 26. 6, 6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0.76 acetate 0.21 methylethenyl-1.15 0.11 27. alfa-Copaene 10.941 0.16 28.	15.	2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl)-	7.894	0.76
(1R)- 2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (1S- endo)- 8.455 0.18 19. 1-Cyclopentene-1-methanol, $q, q.4$ -trimethyl- 8.733 0.87 21. 1,4-Cyclohexadiene-1-methanol, $q, q.4$ -trimethyl- 8.733 0.87 21. 1,4-Cyclohexadiene-1-methanol, $q, q.4$ -trimethyl- 8.733 0.87 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, acetate, (1R,2R,4S)- 9.072 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 acetate 0.69 0.91 0.16 0.76 26. 6, 6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0.76 acetate 10.941 0.16 0.21 0.21 methyl=henkyl-, [1S-(1a,2b,4b)]- 11.058 0.21 0.21 methyl=henkyl-, [1S-(1a,2b,4b)]- 11.058 0.21 0.11 9.858 0.69 11.22 0.36 0.11 <td>16.</td> <td>Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-,</td> <td>8.050</td> <td>1.13</td>	16.	Bicyclo[2.2.1]heptan-2-one, 1,7,7-trimethyl-,	8.050	1.13
17. 2-Cyclohexen-1-0, 1-methyl-4-(1-methylethyl 8.122 0.33 18. Bicyclo[2.2.1]heptan-2-0, 1,7,7-trimethyl-, (1S- endo). 8.455 0.18 19. 1-Cyclopentene-1-methanol, 2-methyl-5-(1-met accetate, 1-methanol, a, ad-trimethyl- methylethyl). 8.733 0.87 21. 1,4-Cyclohexadiene-1-methanol, 4-(1- methylethyl). 8.731 1.22 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, accetate, (1R,2R,4S). 9.072 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, accetate 9.783 0.91 26. 6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0.76 27. alfa-Copaene 10.941 0.16 28. Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- methyl-3-pentenyl). 11.058 0.21 29. Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim 11.392 4.98 31. Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim 11.392 4.98 32. (E)-beta-Famesene 11.625 0.36 33. Humulene		(1R)-		
18. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (1S- endo)- 8.455 0.18 19. 1-Cyclopentene-1-methanol, $\alpha, \alpha 4$ -trimethyl- S.733 0.87 20. 3-Cyclohexadiene-1-methanol, $\alpha, \alpha 4$ -trimethyl- 8.733 0.87 21. 1,4-Cyclopentene-1-methanol, 4 -(1- methylethyl)- 8.733 0.87 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, acetate, (1R,2R,4S)- 9.072 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, acetate 9.783 0.91 26. 6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0.76 27. alfa-Copaene 10.941 0.16 28. Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- 11.058 0.21 29. Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- 11.283 0.11 methyl-3-pentenyl)- 11.392 4.98 31. 31. Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim 11.392 4.98 36 33. Humulene 11.719 0.44 34 36	17.	2-Cyclohexen-1-ol, 1-methyl-4-(1-methylethyl	8.122	0.33
endo)- 19. 1-Cyclopentene-1-methanol, α , α 4-trimethyl-8, 733 0.87 20. 3-Cyclohexene-1-methanol, α , α 4-trimethyl-8, 733 0.87 21. 1, 4-Cyclohexadiene-1-methanol, 4-(1-8, 791 1.22 methylethyl)- 2 Bicyclo[2.2, 1]heptan-2-ol, 1, 3, 3-trimethyl-9, 0.72 0.69 acetate, (1R, 2R, 4S)- 0.73 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2,1]heptan-2-ol, 1,7,7-trimethyl-9, 9.783 0.91 acetate 0.76 0.69 acetate 0.76 0.76 acetate 0.78 0.91 acetate 0.76 0.69 acetate 0.11 0.16 27. alfa-Copaene 10.941 0.16 28. Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-11.058 0.21 methylethenyl)-, [1S-(1a, 2b, 4b)]- 0.21 0.11 9. Bicyclo[5, 2, 0] nonane, 2-methylene-4,8,8-trim 11.392 4.98 31. Bicyclo[5, 2, 0] nonane, 2-methylen-4,8,8-trim 11.392	18.	Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, (1S-	8.455	0.18
19. 1-Cyclopentene-1-methanol, 2-methyl-5-(1-met 8.608 29.56 20. 3-Cyclohexene-1-methanol, q.q.4-trimethyl- 8.733 0.87 21. 1,4-Cyclohexadiene-1-methanol, 4-(1- 8.791 1.22 methylethyl)- 8.791 1.22 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, 9.072 0.69 acetate, (1R,2R,4S)- 9.418 0.73 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 acetate 0.941 0.16 0.76 acetate 0.941 0.16 0.21 methylethenyl)-, [1S-(1a,2b,4b)]- 0.21 0.21 29. Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- 11.283 0.11 methyl-3-pentenyl)- 11.625 0.36 31. Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- 11.506 7.17 methyl-3-pentenyl)- 11.625 0.36 14 32. (E)-betaFamesene 11.625 0.36		endo)-		
20. 3-Cyclohexene-1-methanol, α,α4-trimethyl- methylethyl)- 8.733 0.87 21. 1,4-Cyclohexadiene-1-methanol, 4-(1- methylethyl)- 8.791 1.22 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, acctate, (1R,2R,4S)- 9.072 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, acctate 9.783 0.91 26. 6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0.76 27. alfa-Copaene 10.941 0.16 28. Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- 11.058 0.21 methylethenyl)-, [15-(1a,2b,4b)]- 11.283 0.11 29. Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- 11.283 0.11 methyl-3-pentenyl)- 11.392 4.98 31. Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- 11.506 7.17 33. Humulene 11.719 0.44 34. gamma-Muurolene 11.719 0.44 35. 1,2,4-Metheno-1H-indene, octahydro-1,7a- 12	19.	1-Cyclopentene-1-methanol, 2-methyl-5-(1-met	8.608	29.56
21. 1,4-Cyclohexadiene-1-methanol, 4-(1- methylethyl)- 8.791 1.22 22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, acetate, (1R,2R,4S)- 9.072 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, acetate 9.783 0.91 26. 6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0.76 27. alfaCopaene 10.941 0.16 28. Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- methyl-spentenyl)- 11.058 0.21 29. Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)- 11.283 0.11 30. Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)- 11.392 4.98 31. Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)- 11.556 0.36 33. Humulene 11.719 0.44 34. gamma-Muurolene 11.968 1.08 35. 1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1a,2a,3aβ,4a,5a,7aβ,8S)]- 0.36 36. 3.betaAcetoxy-bisn	20.	3-Cyclohexene-1-methanol, α,α4-trimethyl-	8.733	0.87
methylethyl)-9.0720.6922.Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, accetate, (1R,2R,4S)-9.4180.7323.1,4-dihydroxy-p-menth-2-ene9.4180.7324.1,4-dihydroxy-p-menth-2-ene9.5880.6925.Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, accetate9.7830.9126.6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl10.1860.76accetate10.9410.1627.alfa-Copaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- methylethenyl)-, [1S-(1a,2b,4b)]-11.0580.2129.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.5067.1732.(E)-beta-Famesene11.6250.3633.Humulene11.7190.4434.garma-Muurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylehyl)-, [1S- (1α,2α,3aβ,4α,5α,7aβ,8S)]-3.6636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6637.Betacopaene12.4930.0939.Caryophyllene oxide12.8851.2441.totumologi12.8151.24	21.	1,4-Cyclohexadiene-1-methanol, 4-(1-	8.791	1.22
22. Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, acetate, (1R,2R,4S)- 9.072 0.69 23. 1,4-dihydroxy-p-menth-2-ene 9.418 0.73 24. 1,4-dihydroxy-p-menth-2-ene 9.588 0.69 25. Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, 9.783 0.91 acetate 0.76 0.76 26. 6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl 10.186 0.76 acetate 10.941 0.16 0.21 methylethenyl)-, [1S-(1a,2b,4b)]- 11.058 0.21 methylethenyl)-, [1S-(1a,2b,4b)]- 11.283 0.11 9. Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim 11.392 4.98 31. Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim 11.392 4.98 31. Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim 11.625 0.36 33. Humulene 11.719 0.44 34 gamma-Muurolene 11.968 1.08 35. 1,2,4-Metheno-1H-indene, octahydro-1,7a- 12.115 0.14 dimethyl-5-(1-methylethyl)-, [1S- (1α,2α,3a,8,4α,5α,7a,8,8]]- 0.36 35. 3.betaAcetoxy-bi		methylethyl)-		
acetate, $(1R,2R,4S)$ -23.1,4-dihydroxy-p-menth-2-ene9.4180.7324.1,4-dihydroxy-p-menth-2-ene9.5880.6925.Bicyclo[2.1]heptan-2-ol, 1,7,7-trimethyl-,9.7830.91acetate0.91acetate0.9426.6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl10.1860.76acetate0.9410.1627.alfaCopaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-11.0580.21methylethenyl)-, [1S-(1a,2b,4b)]-9.8icyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.2830.119.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[5.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.5067.17methyl-3-pentenyl)-11.6250.363.32.(E)-betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- (1α,2α,3β,4α,5α,7αβ,88)]-12.2580.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.6020.1739.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8551.24	22.	Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-,	9.072	0.69
23.1,4-dihydroxy-p-menth-2-ene9.4180.7324.1,4-dihydroxy-p-menth-2-ene9.5880.6925.Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, acetate9.7830.9126.6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl10.1860.76acetate10.9410.1627.alfaCopaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-11.0580.21methylethenyl)-, [1S-(1a,2b,4b)]-11.2830.1129.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.2830.11methyl-3-pentenyl)-30.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.5067.1730.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.5067.17methyl-3-pentenyl)-33.Humulene11.7190.4433.Humulene11.7190.4434.gamma-Muurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a-12.1150.14dimethyl-5-(1-methylethyl)-, [1S- (1α,2α,3aβ,4α,5α,7aβ,8S)]-36.3.betaAcetoxy-bisnor5-cholenamide12.2580.3635.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.6020.170.500.50		acetate, (1R,2R,4S)-		
24.1,4-dih/droxy-p-menth-2-ene9.5880.6925.Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, acetate9.7830.9126.6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl10.1860.76acetate10.9410.1627.alfaCopaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-11.0580.21methylethenyl)-, [1S-(1a,2b,4b)]-11.2830.1129.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.2830.1130.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.5067.17methyl-3-pentenyl)-11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1α,2α,3aβ,4α,5α,7aβ,8S)]-12.2580.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.24	23.	1,4-dihydroxy-p-menth-2-ene	9.418	0.73
25.Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, acetate9.7830.9126.6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl acetate10.1860.7627.alfaCopaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- methylethenyl)-, [15-(1a,2b,4b)]-11.0580.2129.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.3924.9830.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim methyl-3-pentenyl)-11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim methyl-3-pentenyl)-11.6250.3632.(E)-betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- (1α,2α,3a,4α,5α,7aβ,8S)]-2.5.36.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.24	24.	1.4-dihvdroxy-p-menth-2-ene	9.588	0.69
acetateacetate10.1426. $6,6$ -Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl10.1860.76acetate10.9410.1627.alfaCopaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-11.0580.21methylethenyl)-, [1S-(1a,2b,4b)]-11.2830.1129.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.2830.11methyl-3-pentenyl)-11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9833.Humulene11.7190.4434.gammaMuurolene11.6250.3633.Humulene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a-12.1150.14dimethyl-5-(1-methylethyl)-, [1S- (1 $\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)$]-0.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.8851.2441.Caryophyllene oxide12.8851	25.	Bicvclo[2.2.1]heptan-2-ol. 1.7.7-trimethyl	9.783	0.91
26. $6,6$ -Dimethylbicyclo[$3.1.1$]hept-2-en-2-yl)methyl10.1860.76acetate10.9410.1627.alfaCopaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- methylethenyl)-, [1S-(1a,2b,4b)]-11.0580.2129.Bicyclo[$3.1.1$]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.2830.1130.Bicyclo[$5.2.0$]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[$5.2.0$]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[$3.1.1$]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-0.367.1732.(E)-betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1 $\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)$]-0.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.8851.2441.Caryophyllene oxide12.8851.24		acetate		
acetate10.9410.1627.alfaCopaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-11.0580.21methylethenyl)-, [1S-(1a,2b,4b)]-0.110.1129.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.2830.11methyl-3-pentenyl)-0.110.1630.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.5067.17methyl-3-pentenyl)-0.447.170.4432.(E)betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a-12.1150.14dimethyl-5-(1-methylethyl)-, [1S- (1 $\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)$]-0.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.2441.taru,Muurolone12.21140.50	26.	6,6-Dimethylbicyclo[3.1.1]hept-2-en-2-yl)methyl	10.186	0.76
27.alfaCopaene10.9410.1628.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- methylethenyl)-, [1S-(1a,2b,4b)]-11.0580.2129.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.2830.1130.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim methyl-3-pentenyl)-11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.5067.1732.(E)betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1α,2α,3aβ,4α,5α,7aβ,8S)]-12.2580.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.6020.1740.Caryophyllene oxide12.8851.2441.trau. Muurolen12.8851.24		acetate		
28.Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1- methylethenyl)-, [1S-(1a,2b,4b)]-11.0580.2129.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.2830.1130.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim methyl-3-pentenyl)-11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.5067.1732.(E)-betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1α,2α,3aβ,4α,5α,7aβ,8S)]-12.2580.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.6020.50	27.	alfaCopaene	10.941	0.16
methylethenyl)-, [1S-(1a,2b,4b)]-29.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.2830.1130.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.5067.17methyl-3-pentenyl)-7732.(E)betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a-12.1150.14dimethyl-5-(1-methylethyl)-, [1S- (1α,2α,3aβ,4α,5α,7aβ,8S)]-12.2580.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.6020.1740.Caryophyllene oxide12.8851.2441.trau. Muurolel12.4110.50	28.	Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-	11.058	0.21
29.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.2830.1130.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.5067.1732.(E)-betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1 $\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)$]-0.1436.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.8851.2441.tau, Muurolen12.8851.24		methylethenyl)-, [1S-(1a,2b,4b)]-		
methyl-3-pentenyl)-30.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-11.5067.17methyl-3-pentenyl)-11.6250.3632.(E)betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1α,2α,3aβ,4α,5α,7aβ,8S)]-12.2580.3636.3. betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.2441.tau. Muurolel12.1110.50	29.	Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-	11.283	0.11
30.Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim11.3924.9831.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.5067.1732.(E)betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- $(1\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)]$ -12.2580.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.6020.1740.Caryophyllene oxide12.8851.2441.tauMuurolol12.1110.50		methyl-3-pentenyl)-		
31.Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4- methyl-3-pentenyl)-11.5067.1732.(E)betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- $(1\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)]$ -12.2580.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.6020.1740.Caryophyllene oxide12.8851.2441.tauMuurolol12.1110.50	30.	Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-trim	11.392	4.98
methyl-3-pentenyl)-11.6250.3632.(E)betaFamesene11.6250.3633.Humulene11.7190.4434.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- $(1\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)]$ -0.1436.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.6020.1740.Caryophyllene oxide12.8851.2441.tau-Muurolol12.1110.50	31.	Bicvclo[3,1,1]hept-2-ene, 2,6-dimethyl-6-(4-	11.506	7.17
32. (E)betaFamesene 11.625 0.36 33. Humulene 11.719 0.44 34. gammaMuurolene 11.968 1.08 35. 1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1 α ,2 α ,3 $a\beta$,4 α ,5 α ,7 $a\beta$,8S)]- 0.14 36. 3.betaAcetoxy-bisnor-5-cholenamide 12.258 0.36 37. Betacopaene 12.314 0.66 38. Trans-Sesquisabinene hydrate 12.602 0.17 39. Caryophyllene oxide 12.885 1.24 41 tau-Muurolol 12.111 0.50	-	methyl-3-pentenyl)-		
33. Humulene 11.719 0.44 34. gammaMuurolene 11.968 1.08 35. 1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1 α ,2 α ,3 α ,3 β ,4 α ,5 α ,7 α β ,8S)]- 0.14 36. 3.betaAcetoxy-bisnor-5-cholenamide 12.258 0.36 37. Betacopaene 12.314 0.66 38. Trans-Sesquisabinene hydrate 12.493 0.09 39. Caryophyllene oxide 12.885 1.24 41. tau-Muurolol 12.111 0.50	32.	(E)-beta-Famesene	11.625	0.36
36.11.16 0.11 34.gammaMuurolene11.9681.0835.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- (1 α ,2 α ,3a β ,4 α ,5 α ,7a β ,8S)]-12.1150.1436.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.2441.tau-Muurolol12.1110.50	33	Humulene	11 719	0 44
35.1,2,4-Metheno-1H-indene, octahydro-1,7a- dimethyl-5-(1-methylethyl)-, [1S- $(1\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)]$ -12.1150.1436.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.2441.tau-Muurolol12.1110.50	34	namma -Muurolene	11 968	1 08
dimethyl-5-(1-methylethyl)-, [1S- (1 α ,2 α ,3 α ,3 β ,4 α ,5 α ,7 α ,7 β ,8S)]-12.2580.3636.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.2441.tau-Muurolol12.1110.50	35	1 2 4-Metheno-1H-indene octahydro-1 7a-	12 115	0.14
$(1\alpha,2\alpha,3a\beta,4\alpha,5\alpha,7a\beta,8S)]$ -36.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.8851.2441.tau-Muurolol12.4110.50	00.	dimethyl-5-(1-methylethyl)- [1.S-	12.110	0.17
36.3.betaAcetoxy-bisnor-5-cholenamide12.2580.3637.Betacopaene12.3140.6638.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.2441.tau. Muurolol12.1110.50		(1a 2a 3aß 4a 5a 7aß 88)]-		
37. Betacopaene 12.314 0.66 38. Trans-Sesquisabinene hydrate 12.493 0.09 39. Caryophyllene oxide 12.885 1.24 40. Caryophyllene oxide 12.885 1.24	36	(ια,2α,0αρ,τα,0α, ι αρ,00)] ⁻ 3 heta -Δαρτογγ-hisnor-5-cholenamide	12 258	0.36
37.Detacopaene12.3140.0038.Trans-Sesquisabinene hydrate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.2441.tau Muurolol12.1110.50	27	Rota -conconc	12.200	0.50
30.Trans-Sesquisabilierie riyurate12.4930.0939.Caryophyllene oxide12.6020.1740.Caryophyllene oxide12.8851.2441.tau Muurolol12.4110.50	30 20	DetaOupaette Trans-Socquicabinana hydrota	12.014	0.00
39. Caryophyliene oxide 12.002 0.17 40. Caryophyllene oxide 12.885 1.24 41. tau Muurolol 12.111 0.50	30. 20	nans-Sesquisabilierie riyurale Convonbyllong gyidg	12.433	0.09
40. Caryophyllette Uxlue 12.000 1.24	39. 40	Caryophyllene oxide	12.002	1.24
	40. ⊿1	tau -Muurolol	12.005	0.50

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S/N	Names of compound	Retention Time	% Composition
42.	Naphthalene, 1,2,3,4,4a,5,6,8a-octahydro-7-	13.372	0.61
12	(1a,4aa,0aa)- 1H-Cucloprop[o]ozulop_4-ol_docobudro_1147-	13 /06	1 24
43.	tetramethyl-, $[1aR-(1a\alpha,4\beta,4a\beta,7\alpha,7a\beta,7b\alpha)]$ -	13.490	1.24
44.	cis-4,7,10,13,16,19-Docosahexanoic acid	13.631	1.17
45.	Cyclooctasiloxane, hexadecamethyl-	13.840	0.07
46.	Butyl 5,8,11,14,17-eicosapentaenoate	13.954	0.29
47.	Caryophyllene oxide	14.499	0.10
48.	n-Propyl 5,8,11,14,17-eicosapentaenoate	14.599	0.15
49.	Caryophyllene oxide	14.685	0.19

Table 4. Chromatographic profile of Ocimum gratissimum leaf oil

S/N	Name of compound	Retention Time	% Composition
1.	alphaPinene	5.532	0.98
2.	2.2-dimethyl-3-	5.711	0.11
	methylidenebicyclo[2.2.1]heptane	-	-
3.	3-Isopropyl-6-methylenecyclohex-1-ene	6.008	0.66
4.	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-	6.066	0.47
	methylene		
5.	Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-	6.221	1.93
	methylene-, (1S)-		
6.	p-Mentha-1,5-diene	6.426	0.26
	Menthadiene		
	1,3-Cyclohexadiene, 2-methyl-5-(1-		
	methylethyl)-		
7.	3,7,7-Trimethylbicyclo[4.1.0]hept-3-ene	6.520	0.18
8.	Bicyclo[4.1.0]hept-2-ene, 3,7,7-trimethyl-,	6.579	1.86
	(1S,6R)-		
9.	Benzene, 1-methyl-3-(1-methylethyl)-	6.624	13.91
10.	Tricyclo[2.2.1.0(2,6)]heptane, 1,3,3-trimethyl-	6.744	0.73
11.	1,3,6-Octatriene, 3,7-dimethyl-, (E)-;	6.841	0.50
12.	p-Mentha-1,4-diene	7.108	14.15
13.	Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1-	7.194	0.65
	methylethyl)-, (1α,2β,5α)-		
14.	Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1-	7.609	1.03
	methylethyl)-, (1α,2β,5α)-		
15.	Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-,	8.419	0.32
	endo-		
16.	3-Cyclohexen-1-ol, 4-methyl-1-(1-	8.601	0.73
	methylethyl)-;		
17.	5-methyl-2-propan-2-ylphenol	9.826	48.04
18.	alfaCopaene	10.941	0.26
19.	Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-	11.057	0.29
	methylethenyl)-, [1S-(1a,2b,4b)]-		
20.	Bicyclo[5.2.0]nonane, 2-methylene-4,8,8-	11.385	1.93
	trimethyl-4-vinyl-		
21.	Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-	11.500	0.18
	methyl-3-pentenyl)-		
22.	Humulene	11.717	0.33
23.	Naphthalene, decahydro-4a-methyl-1-	12.031	3.75
	methylene-7-(1-methylethylidene)-, (4aR-		
	trans)-		
24.	Naphthalene, 1,2,3,4,4a,5,6,8a-octahydro-	12.120	1.33
	4a,8-Naphthalene, 1,2,3,4,4a,5,6,8a		
	octahydro-4a,8-dimethyl-2-(1methylethenyl)-,		
	[2R-(2α,4aα,8aβ)]-Naphthalene,		
	1,2,3,4,4a,5,6,8a-octahydro-4a,8-dimethyl-2-		

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S/N	Name of compound	Retention Time	% Composition
	(1-methylethylidene)-, (4aR-trans)-		•
25.	1H-Cyclopropa[a]naphthalene,	12.332	0.71
	1a,2,3,5,6,7,7a,7b-octahydro-1,1,7,7a-		
	tetramethyl-, [1aR-(1aα,7α,7aα,7bα)]-		
26.	Caryophyllene oxide	12.888	2.65
27.	12-Oxabicyclo[9.1.0]dodeca-3,7-diene,	13.129	0.26
	1,5,5,8-tetramethyl-		
28.	2-Adamantanol, 2-(bromomethyl)-	15.972	0.09
29.	Cyclohexene, 2-ethenyl-1,3,3-trimethyl-	16.225	0.72
30.	2,5,5,8a-Tetramethyl-1,2,3,5,6,7,8,8a-	16.399	0.28
	octahydronaphthalen-1-ol		
31.	3-Adamantan-1-yl-butan-2-one	16.497	0.09
32.	Retinoic acid	17.042	0.08
33.	Cyclohexane, 1,1-bis(5-methyl-2-furyl)-	17.231	0.18
34.	Benzoic acid, 4-[N'-(4,7,7-trimethyl-3-oxo-bic	18.484	0.36





Linalyl butanoate

CH₃



1-Cyclopentene-1-methanol,

2-methyl-5-(1-met)

CH3

H₃C

он

CH3

Thymol

alpha-Bergamotene

H₃C H₃Ć

сн₃



β-Cymene

gamma-Terpinene

CH₃

H₃C





сн₃ H₃C СН₃

p-cymene

Fig. 4. Structure of some common compounds in the study

S/N	Compound	% Composition Ocimum basilicum	% Composition Ocimum canum	% Composition Ocimum gratissimum
1.	alphaPhellandrene	0.26	0.07	0.26
2.	Bicyclo[3.1.0]hexan-2-ol, 2-methyl-5-(1-methy	0.39	7.61	1.03
3.	alfaCopaene	0.08	0.16	0.26
4.	Caryophyllene oxide	0.08	1.24	2.65
5.	Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-m	10.25	7.17	0.18
6.	Humulene	0.77	0.44	0.33
7.	Cyclohexane, 1-ethenyl- 1-methyl-2,4-bis(1-meth	2.44	0.21	0.29
8.	Bicyclo[5.2.0]nonane, 2- methylene-4,8,8-trime	1.55	4.98	1.93

Table 5. Compounds Common to the three species of Ocimum

Table 6. Compounds Common to Ocimum basilicum and Ocimum canum

S/N	Compound	% Composition	
		Ocimum basilicum	Ocimum canum
1.	(+)-2-Bornanone	1.57	1.13
2.	alphaTerpineol	0.69	0.87
3.	Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, acet	0.09	0.69
4.	Bicyclo[2.2.1]heptan-2-ol, 1,7,7 trimethyl-, ace	0.63	0.91
5.	gammaMuurolene	0.63	1.08
6.	betacopaene	2.63	0.66
7.	Naphthalene, 1,2,3,4,4a,5,6,8aoctahydro-7- m	1.66	0.61

Table 7. Compounds common to Ocimum basilicum and Ocimum gratissimum

S/N	Compound	% Composition		
		Ocimum basilicum	Ocimum gratissimum	
1.	Endo-Borneol	0.6	0.32	
2.	Terpinen-4-ol	4.15	0.73	

Table 8. Compounds common to Ocimum canum and Ocimum gratissimum

S/N	Compound	% Composition		
		Ocimum canum	Ocimum gratissimum	
1.	alphaPinene	3.89	0.98	
2.	Camphene	0.4	0.11	
3.	B4.icyclo[3.1.1]heptane, 6,6-dimethyl-2- methyle	2.23	1.93	
4.	gammaTerpinene	3.79	14.15	
5.	Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6- (4-methyl	0.11	0.18	

"Trichomes simply referred to as hair outgrowths of epidermal cells in organisms including plants. Plant trichomes have long been known for their multiple beneficial roles, ranging from protection against insect herbivores and ultraviolet light to the reduction of transpiration" [25]. "Trichomes are widely distributed on the surface of different tissues in different plants, exhibiting various morphologies. Trichomes are generally divided into single-celled or multicellular, branched or unbranched, and glandular or non-glandular based on different characteristics and functions. Trichomes also have different shapes, such as head, star, hook and scale" [26].

"Lignin in plants adds comprehensive strength and stiffness to the plant's cell wall and is believed to play a role in evolution of terrestrial plants by helping them withstand the compressive force of gravity" [27]. "Lignin also waterproofs the cell wall facilitating the upward transport of water in xylem tissues. Lignin has anti-fungal properties and is often rapidly deposited in response to injury by fungi, protecting the plant's body from the diffusion of fungal enzyme and toxins" [27].

Cellulose is a complex carbohydrate or polysaccharide. It is the basis structural component of plants [28]. Cell wall is nondigestible by humans and a food for herbivorous animals [29]. "Tannins are a group of phenolic compounds in woody flowering plants that are important deterrents to herbivores" [30]. "They occur in roots, barks, wood, leaves and fruits of plants and are used in tanning leather, dving fabrics and making ink" [30]. "Tannins are acidic and have astringent taste. They are used in clarification of wine and beer" [31]. "Mucilage is a water-soluble viscous material characterized by a light color, which is part of the fiber. It is formed by some specialized secretory cells of the plant endosperm and its function is to prevent excessive dehydration" [32].

"Ocimum canum is an underutilized medicinal plant that is used for the treatment of gastrointestinal problems and also for the preparation of local soups" [10]. "The leaves have high carbohydrate content, ash, crude fat and crude fiber, but very low in protein and high concentration of calcium with appreciable levels of potassium, sodium, phosphorous and magnesium" [10]. "In addition, the plant was found to be a good source of iron, zinc and manganese. Furthermore, the concentrations of cadmium and lead, which are toxic metals were very low, while the vitamin C content of the leaves was found to be high" [10].

"Essential oils of the leaves of O. canum possess antibacterial (Janssen et al, 1989) and "The chemical insecticidal [33] properties". compositions of the leaves of O. canum reported here differ from those" observed by Philoppe et al. 2013, and Tamil et al., 2015. In Tamil et al., 2015 "the GC-MS analysis of hydro-distilled oil revealed the presence of 36 compounds in O. canum and of which camphor was identified as a major compound which was accounted to be 39.77%, followed by limonene (8.67%), (7.37%), naphthalene valencene (5.80%), caryophyllene (5.60%), a-pinene (5.59%),camphene (5.20%) and myrtenyl acetate (2.74%)". Similarly Martins et al. [9] and Chagonda et al. [34] also reported "camphor as a major compound in certain species of Ocimum including O. canum, O. gratissimum and O. minimum with varied percentage of camphor". "This variation may be due to environmental and physiological factors. On the contrary the essential oil of several chemotypes of O. canum has been reported with a wide range of major compounds like eugenol, citral, b-caryophyllene and methyl cinnamate" [35,36,37,38]. The GC-MS analyses of the three species in this study revealed 35 compounds for O. basilicum, 49 compounds for O. canum and 34 compounds for O. gratissimum. In O. basilicum the most abundant compound is m-Eugenol (34.42%) followed by lindalyl butanoate (20.88%) and alpha-bergamotene (10.25%). In O. canum the most abundant compound is 1-cyclopentaene-1metanol, 2-methyl-5-(met. (29.56) followed by p-Cymene (8.9%), followed by Sabinene hydrate (7.89%) and cis-4-Thyjanol (7.61%) and alphaberganotene (7.17%). In O. gratissinum, Thymol (48.04) is the most abundant followed by gamma-terpinene (14.15%) and m-cymene (13.91%) [39-42].

Eight compounds: (Alpha.-Phellandrene; 2-methyl-5-(1-methy; Bicyclo[3.1.0]hexan-2-ol, Caryophyllene alfa.-Copaene; oxide: Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-m; Humulene; Cyclohexane, 1-ethenyl-1-methyl-2,4-Bicyclo[5.2.0]nonane, bis(1-meth and 2methylene-4,8,8-trime) are present in the three species of Ocimum studied (Table 5). Ocimum bascilicum and O. canum had seven compounds: (+)-2-Bornanone; alpha.-Terpineol; Bicyclo[2.2.1]heptan-2-ol, 1,3,3-trimethyl-, acet; Bicyclo[2.2.1]heptan-2-ol, 1,7,7 trimethyl-, ace; gamma.-Muurolene; beta.-copaene and

Naphthalene, 1,2,3,4,4a,5,6,8aoctahydro-7-m in common (Table 6). Ocimum bascilicum and O. gratissimum had two compounds in common: Endo-Borneol and Terpinen-4-ol (Table 7) While O. canum and O. gratissimum had five alpha.-Pinene: compounds: Camphene: B4.icyclo [3.1.1]heptane, 6,6-dimethyl-2-methyle; gamma.-Terpinene and Bicyclo[3.1.1]hept-2-ene, 2,6-dimethyl-6-(4-methyl in common (Table 8).

5. CONCLUSION

In conclusion, the leaf epidermal microscopy and the chemo-microscopy in this study can be used for the identification and standardization of the plant. The chemical composition of the essential oils from the three Ocimum species could serve as a good source for food and crude drug preparation for the treatment of several diseases.

ACKNOWLEDGEMENT

We acknowledge the DG and all members of TMC NIPRD for providing the enabling environment for the research work. We appreciate all members of staff of MPR & TM Department for their support.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history: The peer review history for this paper can be accessed here: https://www.sdiarticle5.com/review-history/97088