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GC and GC-MS analysis of the dried Leaf and Rhizome essential oil of *Curcuma aurantiaca* Zijp. (Zingiberaceae).

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Abstract: *The chemical investigation on volatile oil obtained by hydrodistillation of air dried leaves and rhizome of Curcuma aurantiaca Zijp. (Zingiberaceae) from Southern india done by GC and GC-MS. The major constituents of the above oils were Caryophyllene (31.07%), 7,11-dimethyl- 3-methylene-(E)- (17.30%), Camphene(4.25%),Beta.-Pinene (2.18%), Phytol (11.32%), Benzofuran (9.06%), alpha-Caryophyllene(3.49%), n-Hexadecanoic acid (2.69%), Naphthalene(2.12%), Caryophyllene oxide (1.83%).This is the first report on the chemical compounds of the essential oil of this species.*

Keywords*: Curcuma aurantiaca Zijp; Rainbow ginger; Zingiberaceae; Essential oil composition; GC-MS; Caryophyllene; Beta-Pinene; Naphthalene; Camphene.*

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I. Introduction

The family Zingiberaceae, generally known as ‘Spice family’, form an important group with considerable economic potential, with genera such as *Aframomum*, K. Schum., *Alpinia* Roxb., *Amomum* Roxb., *Curcuma* L., *Elettaria* Maton., *Kaempferia* L. and *Zingiber* Boehm. Many members of this family have been used in Ayurvedic and other natural system of medicine from time immemorial and some are well known spices. They are also used as medicinal, traditional, food and ornamental plants. Nearly 250species of gingers are used as ornamentals in different parts of the world.

The family consists of rhizomatous perennial herbs with well-developed aerial shoots. Inflorescence is terminal on a leafy shoot or on a short, separate leafless shoot arising directly from the rhizome. Flower is zygomorphic, epigynous and bisexual. The family is characterized by the fusion of the lateral staminodes of the inner staminal whorl into labellum, presence of two epigynous glands and occurrence of cells containing essential or ethereal oils are unique features which distinguish this family from other families of Zingiberales.Volatile oil containing drugs and essential oils have been used for a long time both in folk medicines and in therapeutics, both traditional and alternative. Essential oils, the volatile secondary metabolites responsible for the odours of aromatic plants are used in perfumery, as aroma products, flavouring agents in food and beverages, in cosmetic products and as drugs. There is an increasing global trend in the consumption of self-prescribed herbal and natural products for treating numerous ailments such a cancer and even by healthy individuals as preventive measures (Teixeirada Silva, 2004). A GC-MS machine with computerized library search discs are regarded as the best tool for essential oil analysis (Jose and Rajalakshmi, 2005).

The genus *Curcuma* L., with around 120 species distributed in tropical and subtropical Asia, consists of a rather homogenous group of rhizomatous perennials .In India about 29 species, distributed almost all states. The genus is easily recognized by its inflorescence, a spike with prominent spiral bracts, which laterally fuse or adnate to the peduncle and form pouches, each subtending a cincinnus of flowers, and a cluster of, often coloured, sterile, terminal bracts called ‘coma’. *C. aurantiaca* Zijp. commonly called “Rainbow ginger”shows a high range of variation in floral characters, which gives a highly appreciable position to this species. The plant is medium sized with small rhizomes and tubers. Inflorescence is central in position and the main attraction is the incredibly colourful nature of the inflorescence. The bract colour ranges from green, white, brown, purple to rose. Its specific epithet comes from the unusual striking colour of the flowers (Skornickova *et al*, 2004).

II. Materials And Methods

Shade dried aerial plant parts and rhizomes of wild *Curcuma aurantiaca* species were hydrodistilled separately in a Clevenger-type apparatus (Clevenger, 1928) at 100 ^{o} C for 4 hours as prolonged extraction normally increases the yield (Gildemeister and Hoffman, 1961). Volatile oil was collected over water. The sample was cooled to room temperature and allowed to stand until oil layers were clear and finally the extracted oil was collected. The oils thus obtained were dried over anhydrous sodium sulfate and kept in refrigerator at 4 ^{0} C prior to analysis.

GC-MS analysis

GC was performed on a 6850 network GC system, Agilent technologies and MS was recorded on a 5975C VLMSD with triple axis detector Agilent technologies under the following temperature conditions: 5 min at 60^0 C, then rising at 50 C/min to 110^0 C, then 3^0 C from 110^0-200 ^{0} C, then 50 C/min to 220^0 C and maintained at 220^0 C for 5 minutes. Helium was used as the carrier gas and sample was injected in split mode.

Identification of Compounds: Compounds were identified by comparing the retention indices of the peaks on a RTX wax column with literature values, computer matching against the library spectra built up using pure substances and components of known essential oils and finally confirmed by comparison of mass spectra of peaks and retention indices with published data (Mc – Carron et al., 1995, Adams, 1989, Swigar and Silverstein, 1987, Ramaswamy *et al*., 1988). The relative proportion of each individual component of the oil was expressed as a percentage relative to the total peak area.

III. Results And Discussion

21 compounds were detected from the essential oil of *C. aurantiaca* rhizome. The chemical profile shows the rhizome and leaf oil of *C. aurantiaca* were the same in its oil components. Phytochemical compositions of essential oils in *C. aurantiaca* are reported for the first time. The analysis of essential oil from the leaves of *C. aurantiaca* detected the following compounds. Caryophyllene (31.07%), 7,11-dimethyl- 3-methylene-(E)- (17.30%), Camphene (4.25%), Beta.-Pinene (2.18%), Phytol (11.32%),Benzofuran (9.06%) 1,6,10-Dodecatrien- 3-ol (6.65%), alpha-Caryophyllene(3.49%), n-Hexadecanoic acid (2.69%)1, 6, 10-Dodecatriene, Naphthalene(2.12%), Caryophyllene oxide (1.83%). The GC-MS profile of the *C.aurantiaca* essential oils are presented in **Fig.2.**

In the present investigation we detected a number of compounds that were identified from the different species could be used as marker compounds to distinguish between the different species .Essential oil yield was too low in some species, thus its chemical characterization was not possible. Moreover, the distribution of the species is scanty to repeat the experiment. The extraction of essential oils from both rhizome and leaves were not possible for all the species. In some species both the rhizome and leaf extraction yielded essential oils, but in some cases either leaf or rhizome provided oil or in some cases neither of them yields good quality and quantity oil. Many compounds present in small quantities were not included in this analysis because they could not be readily identified due to insufficient mass spectrum quality or because their relative concentration could not be adequately evaluated. The composition of the essential oils from a particular species can differ between harvesting seasons, extraction methods and geographical sources and that those from the different parts of the same plant can also differ widely (Burt, 2004).

Fig.1. Curcuma aurantiaca

Components of essential oil of *Curcuma aurantiaca*

Components	Concentration (%)
Camphene	4.25
Beta.-Pinene	2.18
Cyclohexane	4.18
Caryophyllene	31.07
alpha.-Caryophyllene	3.49
1, 6, 10-Dodecatriene, 7,11-dimethyl- 3-methylene- , (E)-	17.30
Benzofuran	9.06
5-Chloropentanoic acid	1.94
5-Benzofuranacetic acid	1.94
Naphthalene	2.12
1H-Cycloprop[e]azulene	1.93
1,6,10-Dodecatrien- 3-ol	6.65
Caryophyllene oxide	1.83
n-Hexadecanoic acid	2.69
Phytol	11.32

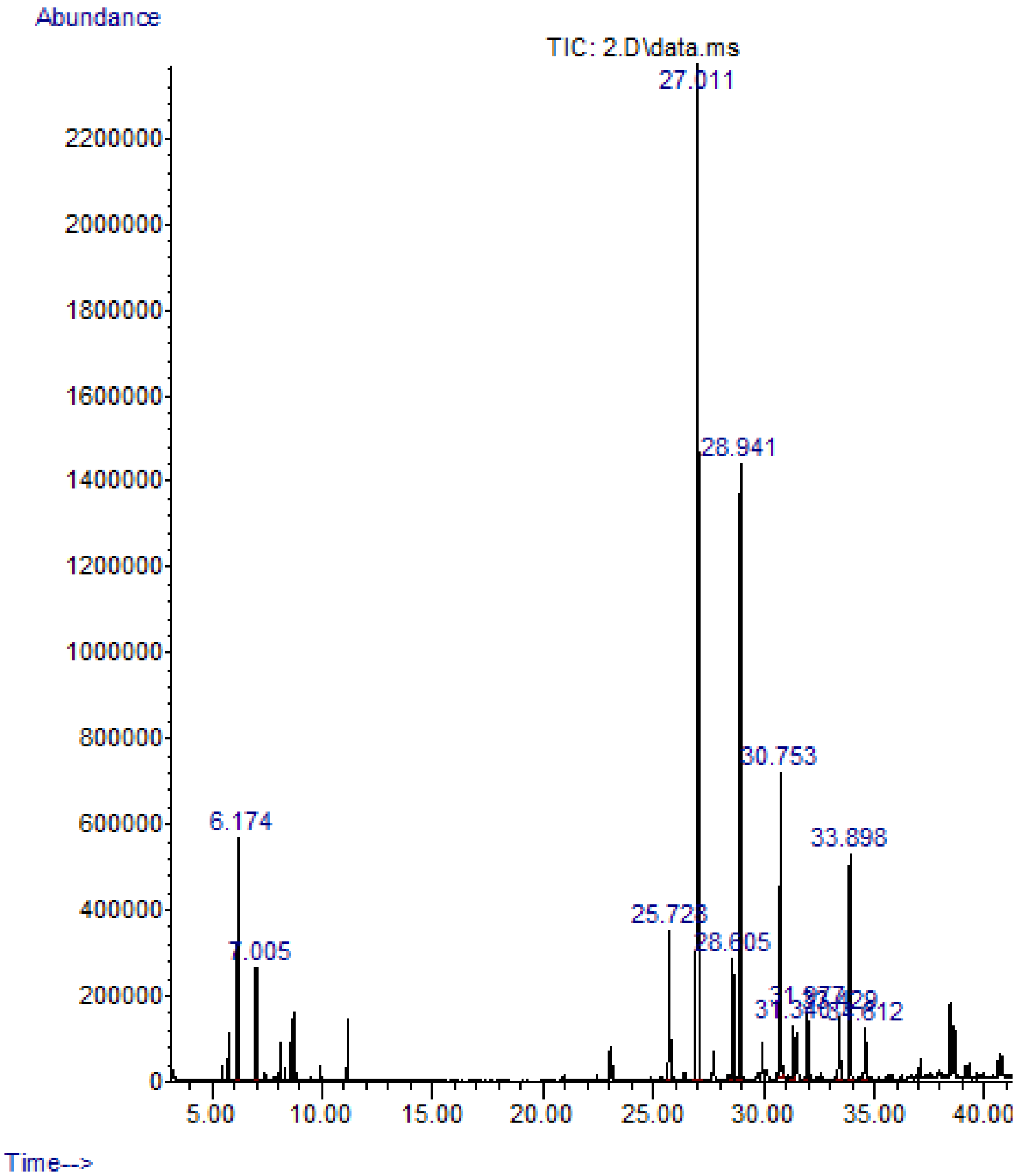
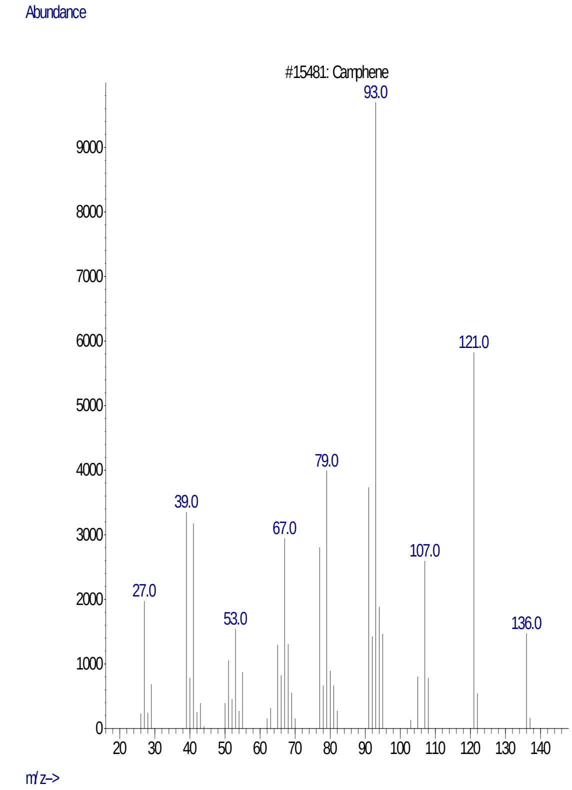


Fig. 2. GC-MS ion chromatograms of volatile components from *C. aurantiaca* leaf oil


Abundance
#15481: Camphene
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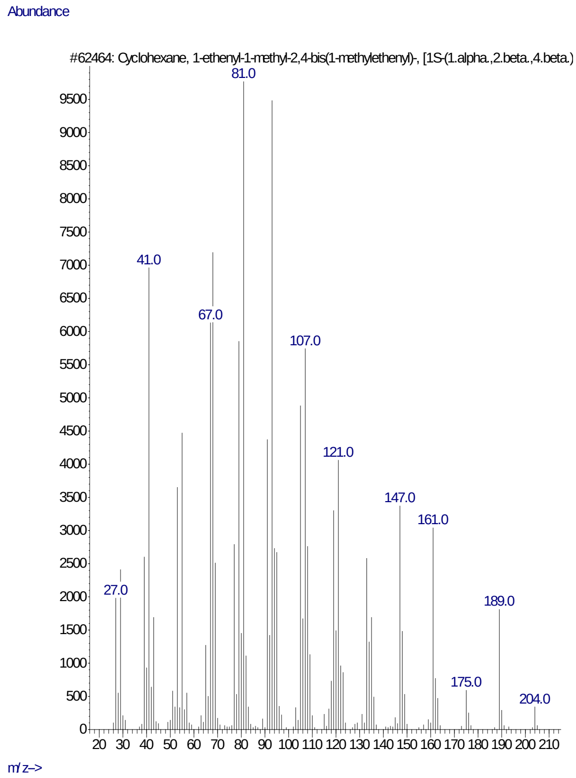
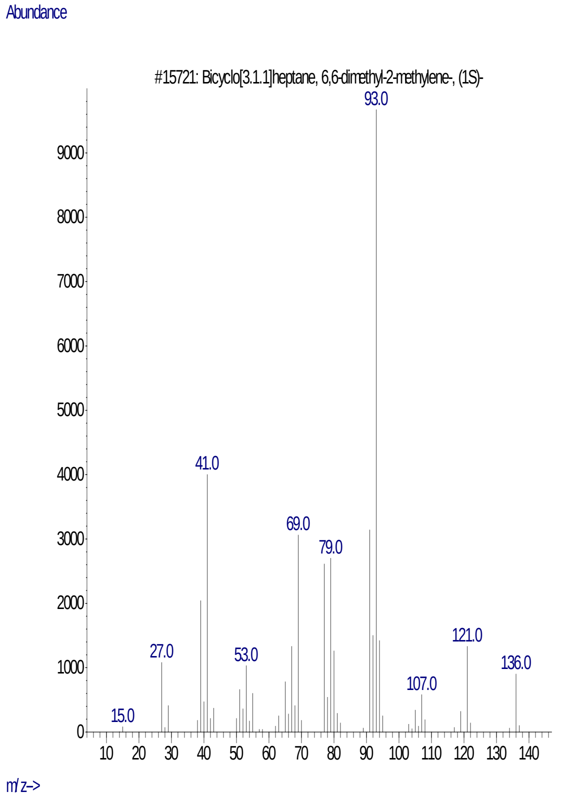
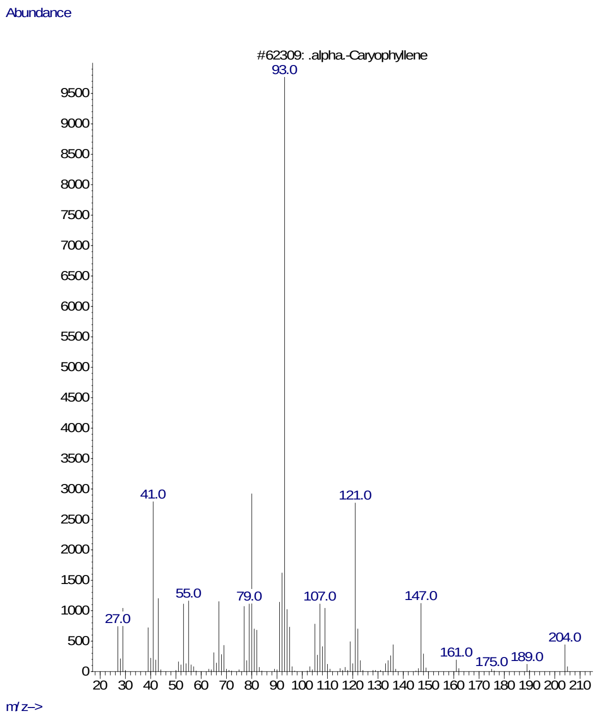
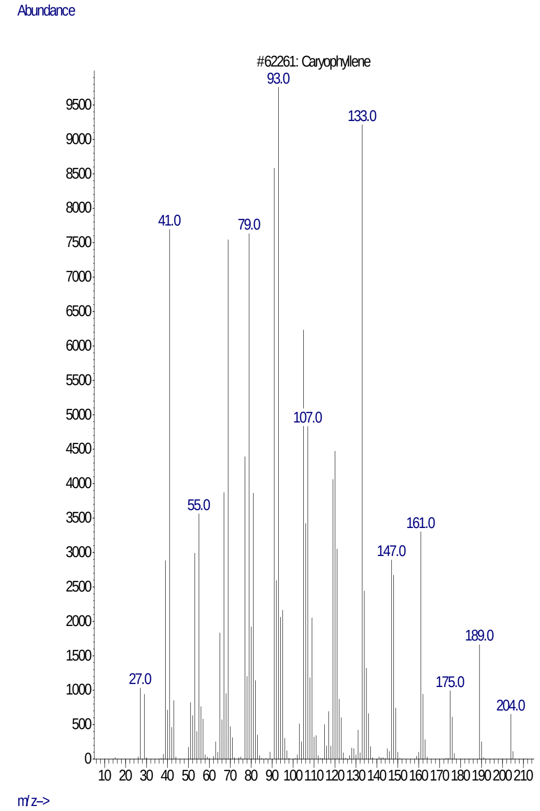
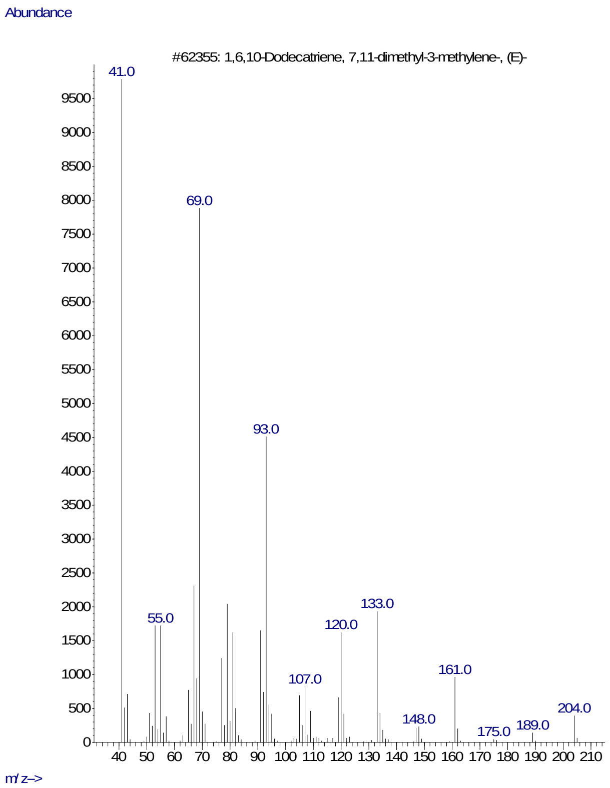
121.0
79.0
39.0
67.0
107.0
27.0
53.0
136.0
m/z-->

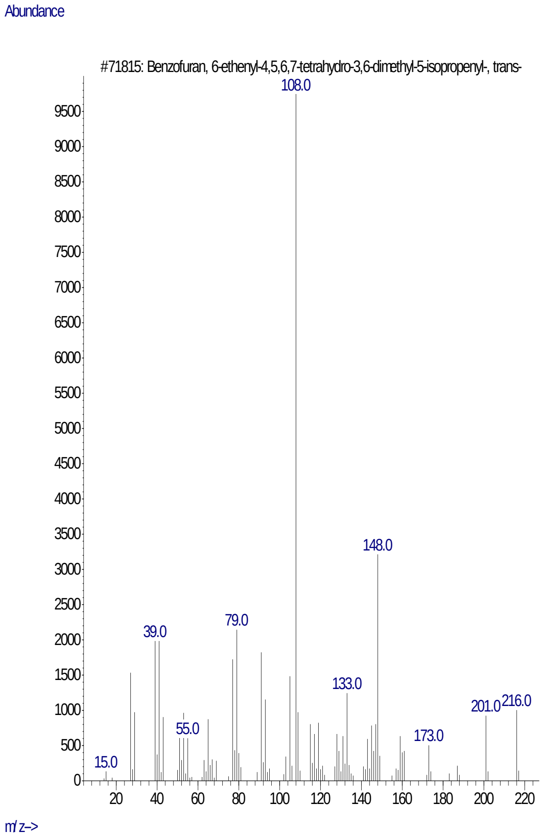

Abundance
#62464: Cyclohexane, 1-ethenyl-1-methyl-2,4-bis(1-methylethenyl)-, [1S-(1.alpha.,2.beta.,4.beta.)
81.0
41.0
67.0
107.0
121.0
147.0
161.0
27.0
189.0
175.0
204.0
m/z-->


Abundance
#15721: Bicyclo[3.1.1]heptane, 6,6-dimethyl-2-methylene-, (1S)-
93.0
41.0
69.0
79.0
121.0
27.0
53.0
136.0
107.0
15.0
m/z-->


Abundance
#62309: .alpha.-Caryophyllene
93.0
41.0
121.0
55.0
79.0
107.0
147.0
27.0
204.0
161.0
175.0
189.0
m/z-->


Abundance
#62261: Caryophyllene
93.0
133.0
41.0
79.0
107.0
55.0
161.0
147.0
189.0
27.0
175.0
204.0
m/z-->


Abundance
#62355: 1,6,10-Dodecatriene, 7,11-dimethyl-3-methylene-, (E)-
41.0
69.0
93.0
55.0
133.0
120.0
107.0
161.0
148.0
175.0
189.0
204.0
m/z-->


Abundance
#71815: Benzofuran, 6-ethenyl-4,5,6,7-tetrahydro-3,6-dimethyl-5-isopropenyl-, trans-
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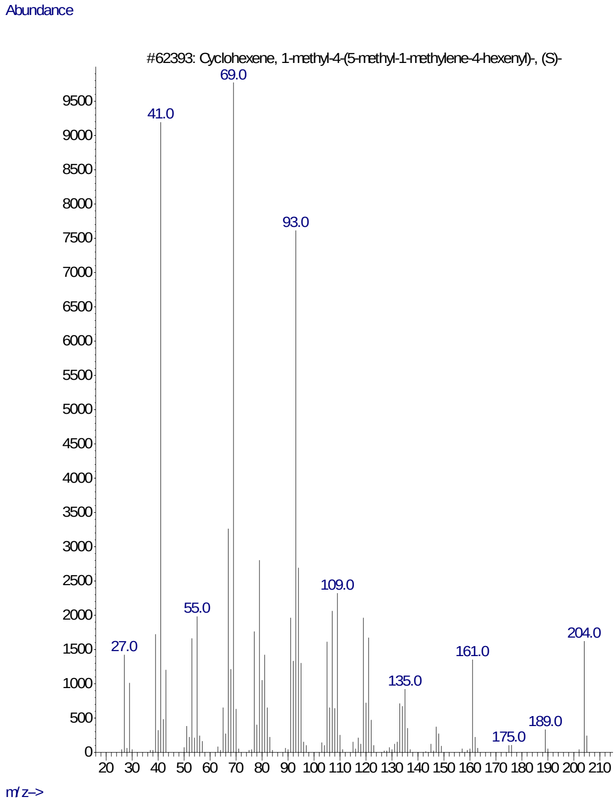
148.0
39.0
79.0
133.0
201.0
216.0
55.0
173.0
15.0
m/z-->


Abundance
#62393: Cyclohexene, 1-methyl-4-(5-methyl-1-methylene-4-hexenyl)-, (S)-
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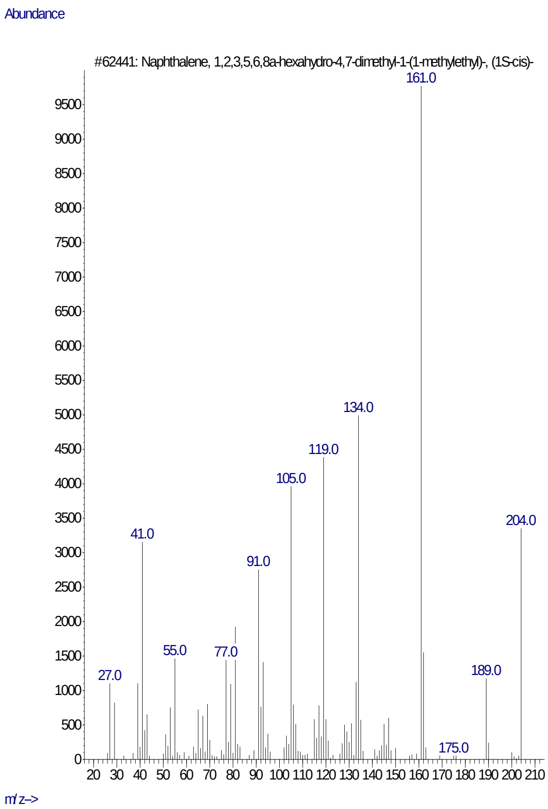
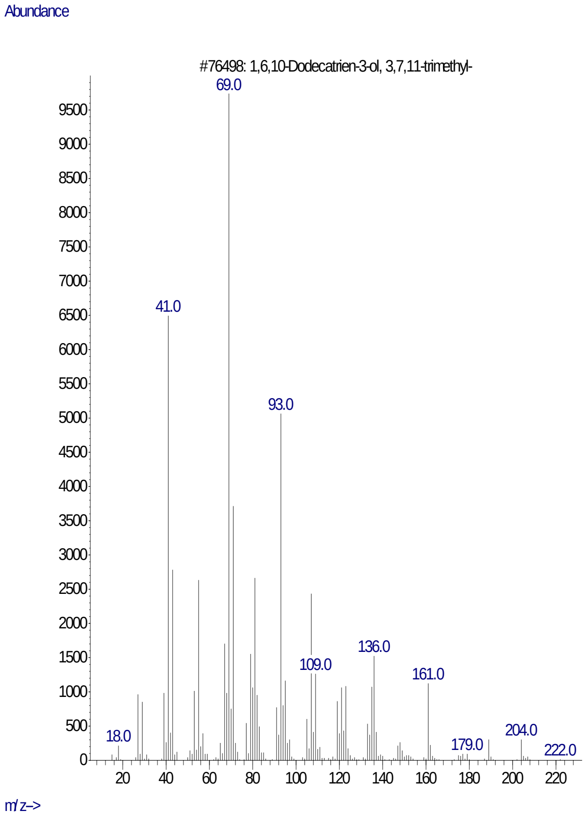
41.0
93.0
109.0
55.0
204.0
27.0
161.0
135.0
189.0
175.0
m/z-->


Abundance
#62441: Naphthalene, 1,2,3,5,6,8a-hexahydro-4,7-dimethyl-1-(1-methylethyl)-, (1S-cis)-
161.0
134.0
119.0
105.0
204.0
41.0
91.0
55.0
77.0
27.0
189.0
175.0
m/z-->


Abundance
#76498: 1,6,10-Dodecatrien-3-ol, 3,7,11-trimethyl-
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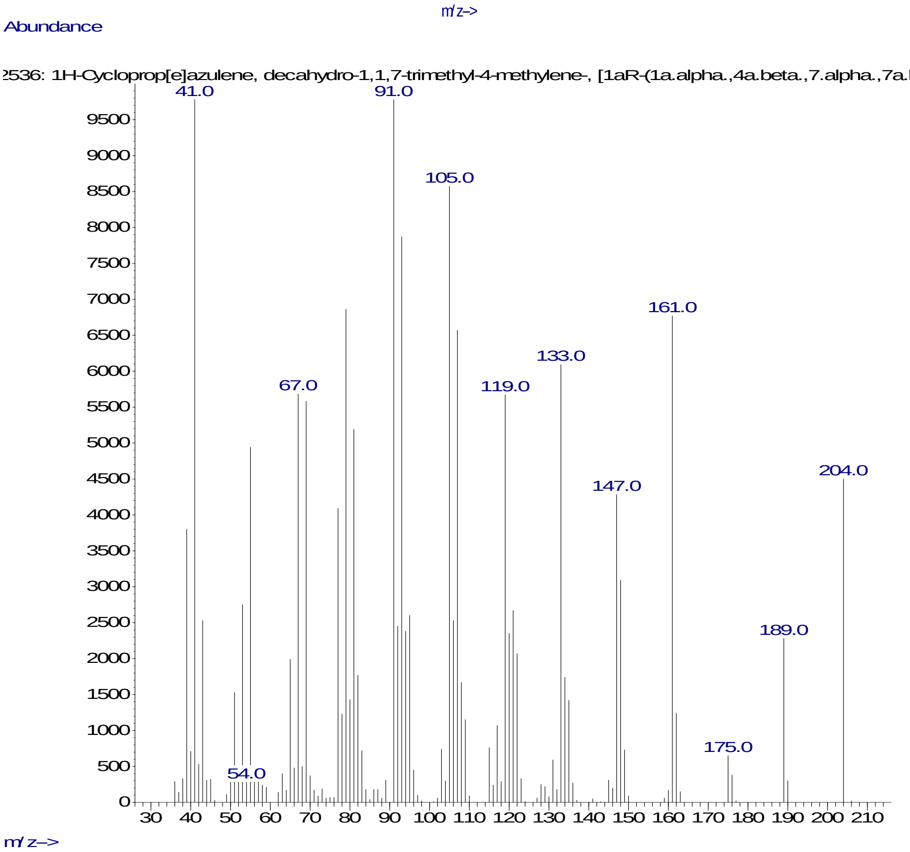
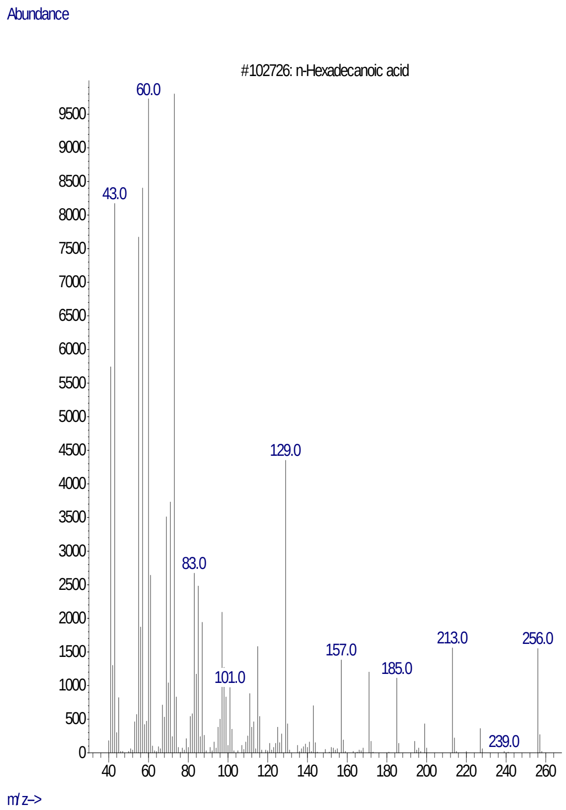
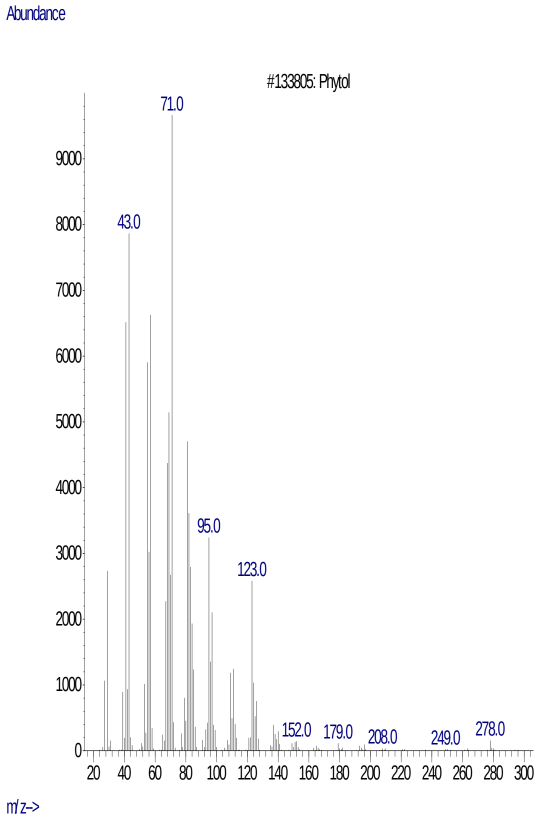
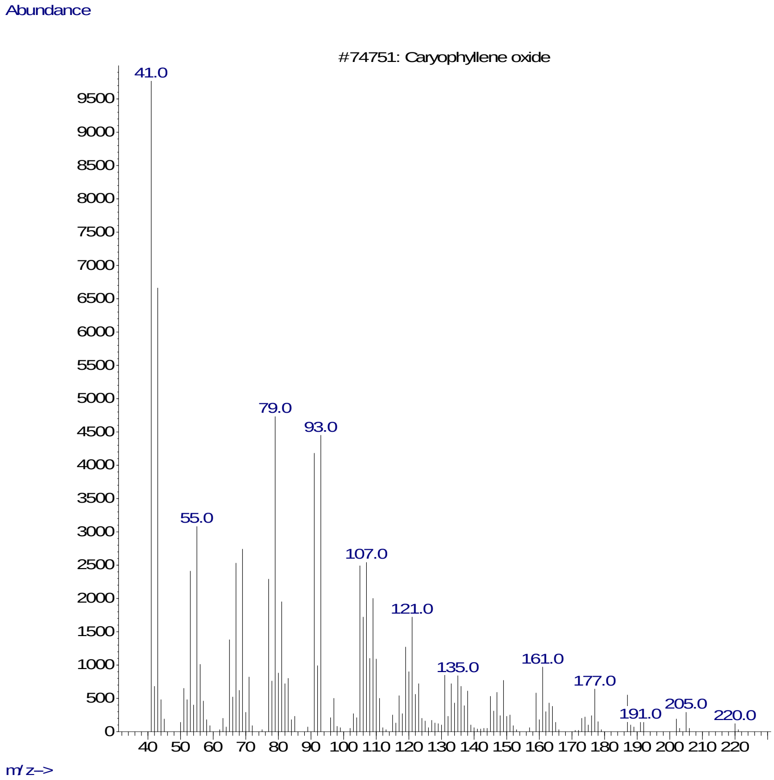
41.0
93.0
136.0
109.0
161.0
18.0
179.0
204.0
222.0
m/z-->


Abundance
2536: 1H-Cycloprop[e]azulene, decahydro-1,1,7-trimethyl-4-methylene-, [1aR-(1a.alpha.,4a.beta.,7.alpha.,7a.
41.0
91.0
105.0
161.0
133.0
67.0
119.0
147.0
204.0
189.0
175.0
54.0
m/z-->







Acknowledgements

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