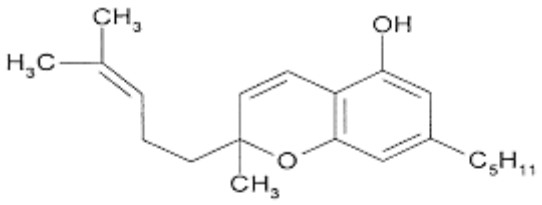
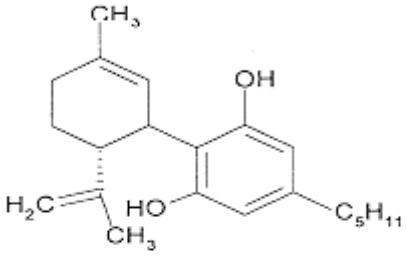
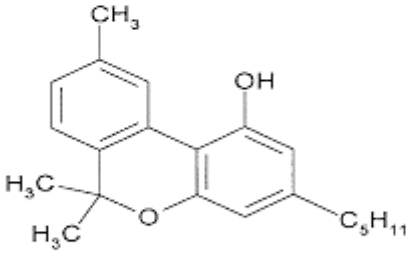


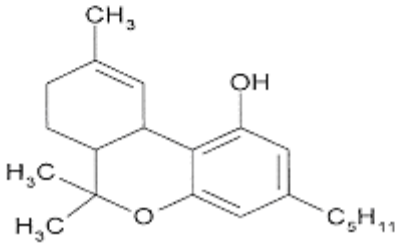
Cannabichromene



Cannabidiol



Cannabinol



Delta 9-Tetrahydrocannabinol

1. SYNONYMS

CFR: Marijuana (Schedule I)

CAS #: Marijuana: 8063-14-7
Delta 9-tetrahydrocannabinol: 1972-08-3
Cannabidiol: 13956-29-1
Cannabinol: 521-35-7

Cannabichromene
Cannabigerol
Cannabicyclol

Other Names:

Cannabis
Bhang
Ganja
Weed
Mary Jane
MJ
Reefer
Doobie
Joint
Roach
Smoke-Smoke
Pot
Hemp
Homegrown
Grass

2. CHEMICAL AND PHYSICAL DATA

2.1. CHEMICAL DATA

Form	Chemical Formula	Molecular Weight
Delta 9-tetrahydrocannabinol	$C_{21}H_{30}O_2$	314.5
Cannabidiol	$C_{21}H_{30}O_2$	314.5
Cannabinol	$C_{21}H_{26}O_2$	310.4
Cannabigerol	$C_{21}H_{32}O_2$	316.5
Cannabicyclol	$C_{21}H_{30}O_2$	314.5

2.2. SOLUBILITY

The cannabinoids are soluble in ethyl ether, hexane, petroleum ether, chloroform and alcohol.

3. SCREENING TECHNIQUES

3.1. MICROSCOPIC EXAM

Marijuana: A small portion of sample is placed on a microscope slide or in a suitable container and examined under a low power microscope, 25x to 100x. Viewing can be enhanced by adding a drop of water to the sample and flattening the material on the slide with a cover glass. The most common features are the cystolith hairs, resin glands and glandular hairs. The glandular hairs are either unicellular or multicellular; the multicellular hairs have 8 to 16 cells. The cystolith hairs contain a deposit of calcium carbonate at the base of the hair.

When a drop of 20% hydrochloric acid is added to the calcium carbonate deposit, a characteristic effervescence is observed.

Hashish: Place a small portion of sample on a microscope slide and add a drop of chloral hydrate solution to the sample. Cover with a cover glass and view the slide at medium to high magnification (60x to 200x). Observe the presence of characteristic plant particles, especially cystolithic hairs, glandular hairs, and resin glands. If the solution is cloudy or highly colored, gently heat the slide to clear the solution.

3.2. *COLOR TESTS*

REAGENT	COLOR PRODUCED
Duquenois-Levine	Violet to purple color in chloroform layer

Procedure:
Modified Duquenois-Levine: Place 30 mg to 100 mg of material in a small container, cover with petroleum ether and filter into a small test tube. Evaporate to dryness on a steam bath. Add a small amount of Modified Duquenois-Levine reagent and an equal amount of concentrated hydrochloric acid, stir, and let stand for a few minutes. A blue to purple color will develop. Add a small portion of chloroform, shake, and let the layers separate. A violet to purple color in the chloroform layer indicates a positive test for cannabinoids. The Duquenois-Levine reagent may be added directly to a few drops of hashish, proceeding as above.

3.3. THIN LAYER CHROMATOGRAPHY (TLC)

Visualization

Fast Blue 2B salt

The locator reagent is 15 mg Fast Blue 2B salt in 20 mL methanol. This solution is unstable and should be prepared fresh.

COMPOUND	Relative R1 and Color	
	System TLC 9	System TLC 10
Cannabichromene	0.6, purple	0.8, purple
Cannabigerol	0.8, pink	0.8, pink
Cannabinol	0.8, purple	0.9, purple
Delta-9-tetrahydrocannabinol	1.0, red	1.0, red
Delta-8-tetrahydrocannabinol	1.1, red	1.1, red
Cannabidiol	1.1, yellow-orange	1.1, yellow-orange
Cannabicyclol	1.2, pink	1.2, pink

3.4. GAS CHROMATOGRAPHY (GC)

Method MAR-GCS1

Instrument: Gas chromatograph operated in split mode with FID

Column: 5% diphenyl/95% dimethylsiloxane 30m x 0.25mm x 0.25µm film thickness

Carrier gas: Helium at 1.1 mL/min

Temperatures: Injector: 260°C
Detector: 280°C
Oven program:
1) 70°C initial temperature for 2.0 min
2) Ramp to 250°C at 30°C /min
3) Hold final temperature for 7.0 min

Injection Parameters: Split Ratio = 50:1, 1 µL injected

Samples can be extracted with petroleum ether or appropriate solvent and filtered.

COMPOUND	RRT	COMPOUND	RRT
cannabicyclol	0.89	**delta 9-tetrahydrocannabinol**	**1.00 (7.9 min)**
cannabichromene	0.91	cannabigerol	1.02
cannabidiol	0.92	cannabinol	1.05
delta 8-tetrahydrocannabinol	0.98		

4. CONFIRMATORY TECHNIQUES

4.1 GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

Method MAR-GCMS1

Instrument: Gas chromatograph operated in split mode with MS

Column: 5% diphenyl/95% dimethylsiloxane 15 m x 0.25 mm x 0.25 µm film thickness

Carrier gas: Helium at 1.0 mL/min

Temperatures: Injector: 260°C

Detector: 280°C
Oven program:
1) 270°C Isothermal
2) Hold time 2.8 min

Injection Parameters: Split Ratio = 20:1, 1 µL injected

Samples can be extracted with petroleum ether or appropriate solvent and filtered.

COMPOUND	RRT	COMPOUND	RRT
cannabicyclol	0.73	**delta 9-tetrahydrocannabinol**	**(1.35 min.) 1.00**
cannabidiol	0.81	cannabigerol	1.09
cannabinol	1.16		

Method MAR-GCMS2

Instrument: Gas chromatograph operated in splitless mode with MS

Column: DB5-MS 30 m x 0.25 mm x 0.25 µm film thickness

Carrier gas: Helium at 1.3 mL/min

Temperatures: Injector: 250°C
Oven program:
1) 180°C hold for 1 min
2) Ramp 25°C/min to 260°C
3) Ramp 39°C/min to 310°C, hold 4 min

Injection Parameters: Split Ratio = splitless, 1 µL injected
Purge time 0.6 min

Samples can be extracted with petroleum ether or appropriate solvent and filtered.

COMPOUND	RRT	COMPOUND	RRT
cannabicyclol	0.58	**delta 9-tetrahydrocannabinol**	**(5.72 min.) 1.00**
cannabidiol	0.73	cannabigerol	1.11
cannibinol	1.19		

4.2 GAS CHROMATOGRAPHY/IFRARED SPECTROPHOTOMETRY (GC/IR)

Method MAR-GCIR1

Instrument:	Gas chromatograph operated in splitless mode with IR
Column:	HP5 30 m x 0.32 mm x 0.25 µm film thickness
Carrier gas:	Helium at 2.2 mL/min
Temperatures:	Oven program: 1) 130°C hold for 1 min 2) Ramp 20°C/min to 200°C, hold for 1 min 3) 40°C/min to 290°C, hold for 3 min
Injection Parameters:	Splitless, 1 µL injected, purge time 0.75 min

Samples can be extracted with petroleum ether or appropriate solvent, dried, and filtered.

COMPOUND	RRT	COMPOUND	RRT
cannabicyclol	0.57	**delta 9-tetrahydrocannabinol**	**(8.37 min.) 1.00**
cannabidiol	0.75	cannabigerol	1.19
cannabinol	1.25		

5. SEPARATION TECHNIQUES

The cannabinoids are separated from the plant material and resins by solvent extraction with petroleum ether. Petroleum ether also removes some plant waxes, but does not remove other plant materials such as chlorophyll. After evaporation of the petroleum ether, the cannabinoids are separated from the plant waxes by solvent extraction with methanol. The methanol soluble cannabinoids can then be separated by GC, HPLC, or TLC.

6. QUANTITATIVE PROCEDURES

N/A

7. QUALITATIVE DATA

7.1. ULTRAVIOLET SPECTROSCOPY (UV)

COMPOUND	SOLVENT	MAXIMUM ABSORBANCE (nm)

cannabichromene	methanol	230
cannabidiol	methanol	274
cannabinol	methanol	232
delta 9-tetrahydrocannabinol	methanol	283

See spectra on the following pages for FT/IR, GC/MS, GC/IR, and NMR.

8. REFERENCES

Budavari, S., *The Merck Index, 12th Edition*, Merck and Co., Inc., 1996, p. 1573-74.
Clarke, E.G.C., *Isolation and Identification of Drugs, 2nd Edition*, The Pharmaceutical Press, 1986.

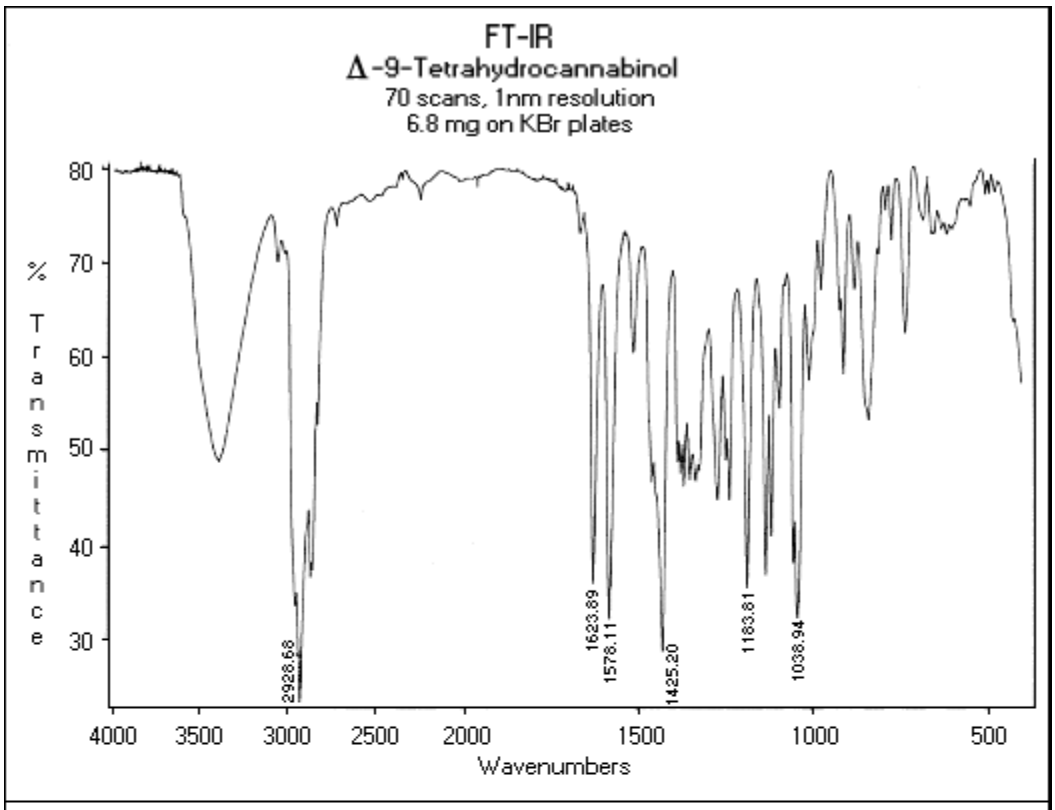
Clarke, E.G.C., Clarke's Analysis of Drugs and Poisons, 3rd Edition, Volume 1, The Pharmaceutical Press, 2004, p. 285. (Appendix A)

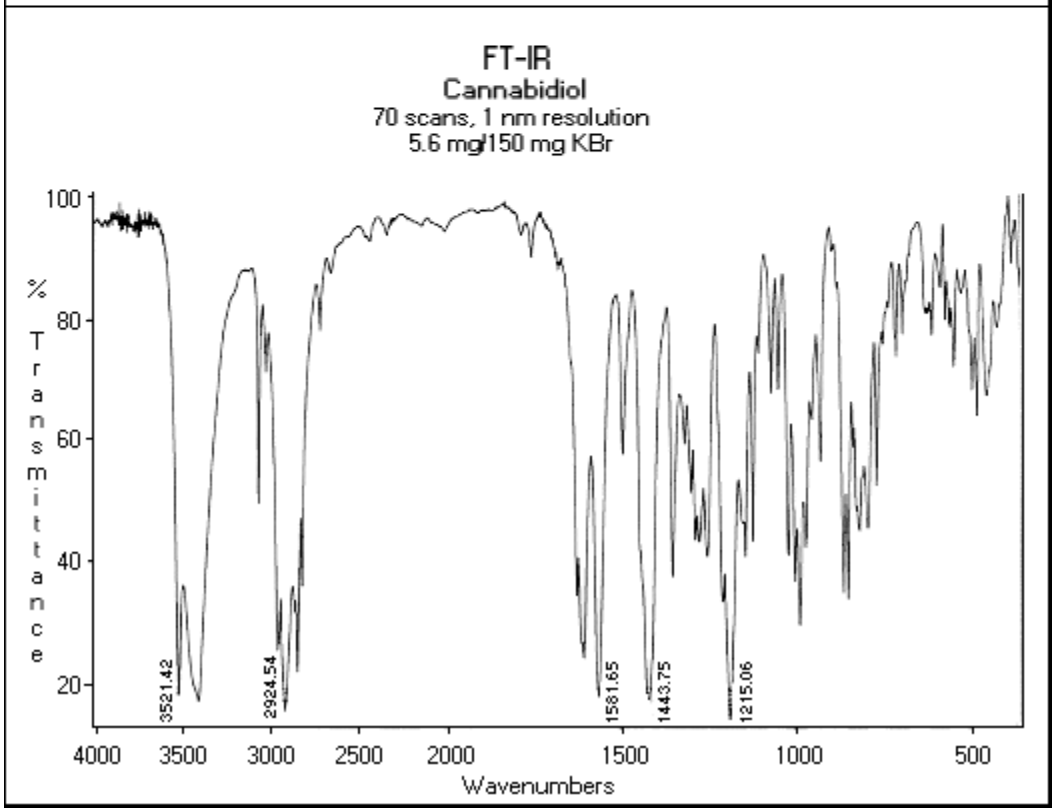
Marnell, Tim, Drug Identification Bible, 4th Edition, Amera-Chem, Inc., 1999.
Mills III, Terry, Robertson, J. Conrad, Instrumental Data for Drug Analysis, 2nd Edition, Volume 1, CRC Press, 1993, pp. 306 and 310.

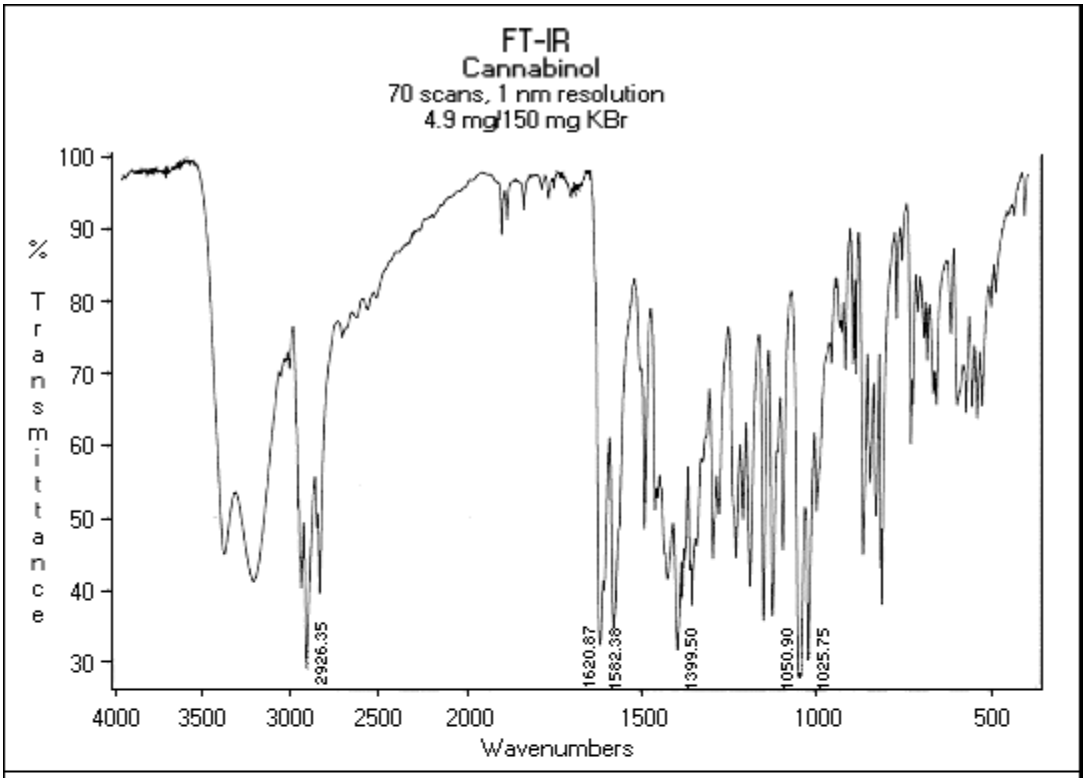
9. ADDITIONAL RESOURCES

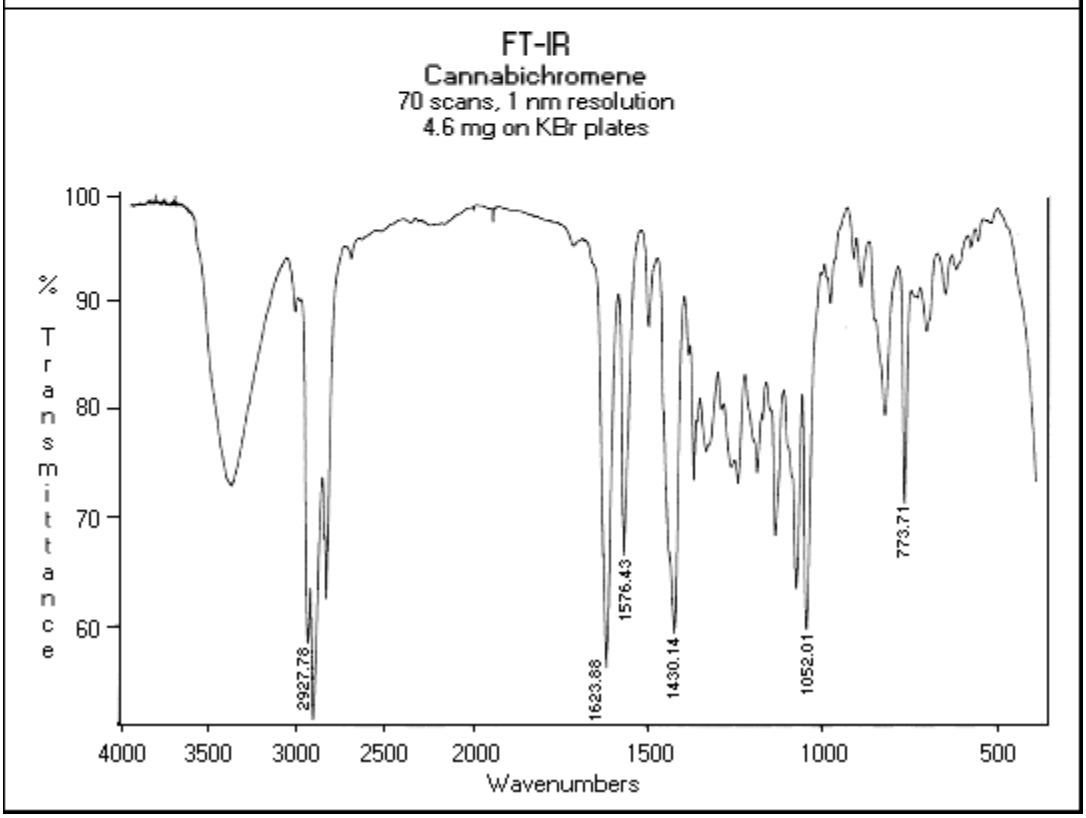
Forendex

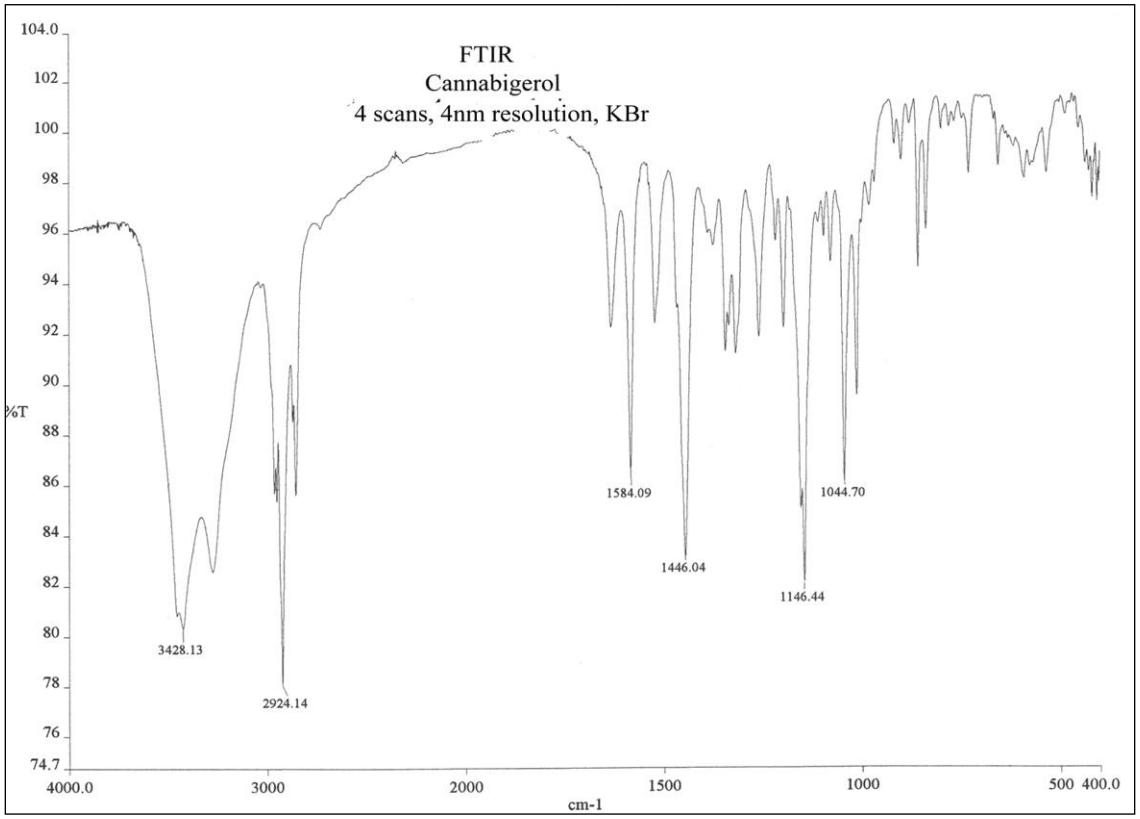
Wikipedia

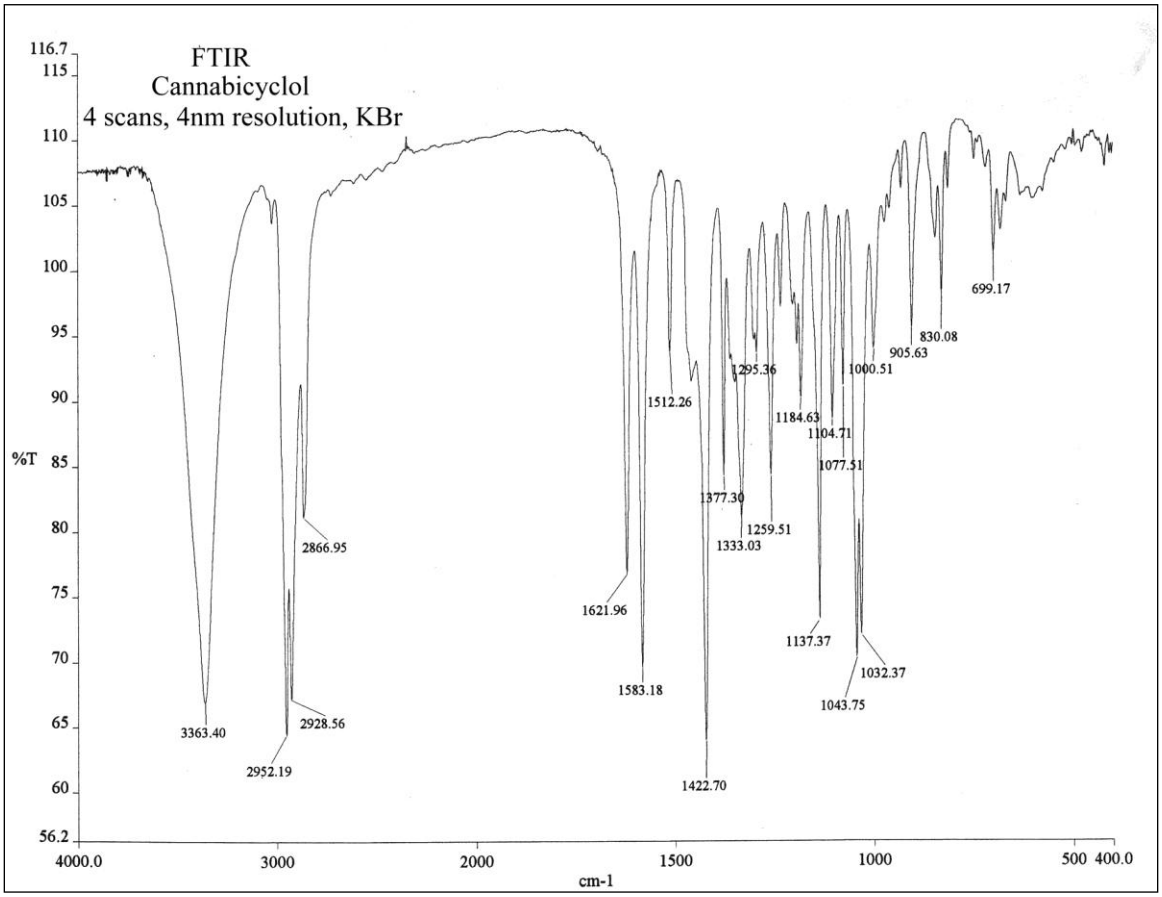

FT-IR
Δ-9-Tetrahydrocannabinol
70 scans, 1nm resolution
6.8 mg on KBr plates
% Transmittance
80
70
60
50
40
30
2928.66
1623.89
1578.11
1425.20
1183.81
1038.94
4000
3500
3000
2500
2000
1500
1000
500
Wavenumbers


FT-IR
Cannabidiol
70 scans, 1 nm resolution
5.6 mg/150 mg KBr
% Transmittance
100
80
60
40
20
3521.42
2924.54
1581.65
1443.75
1215.06
4000
3500
3000
2500
2000
1500
1000
500
Wavenumbers

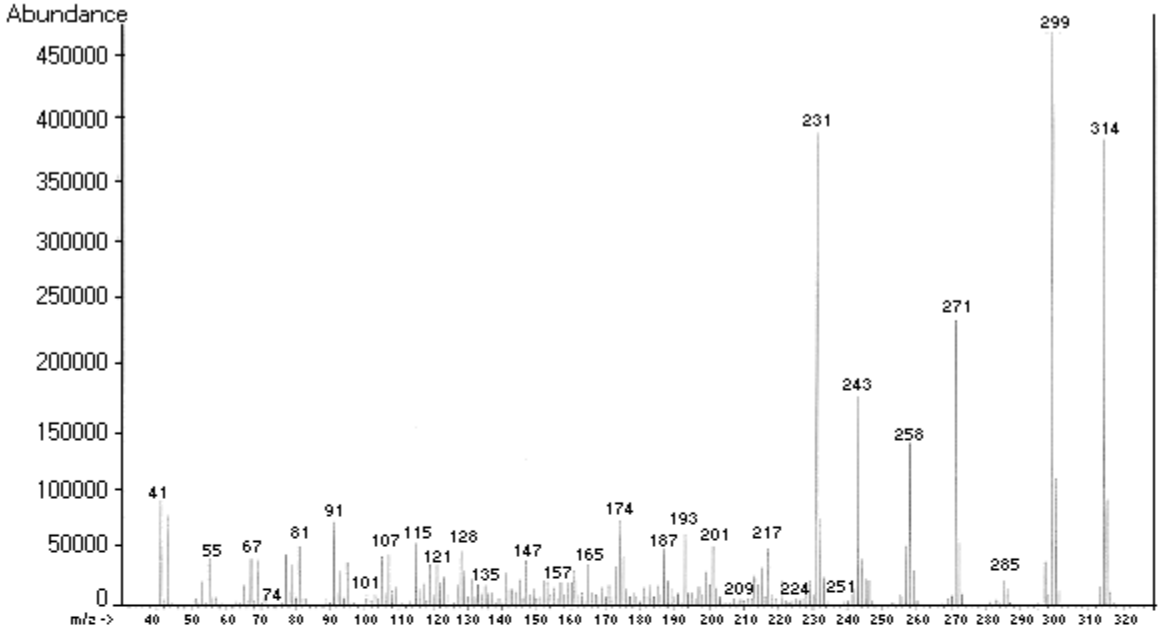

FT-IR
Cannabinol
70 scans, 1 nm resolution
4.9 mg/150 mg KBr
% Transmittance
100
90
80
70
60
50
40
30
2926.35
1620.87
1582.38
1399.50
1050.90
1025.75
4000
3500
3000
2500
2000
1500
1000
500
Wavenumbers


FT-IR
Cannabichromene
70 scans, 1 nm resolution
4.6 mg on KBr plates
% Transmittance
100
90
80
70
60
2927.78
1623.88
1576.43
1430.14
1052.01
773.71
4000
3500
3000
2500
2000
1500
1000
500
Wavenumbers

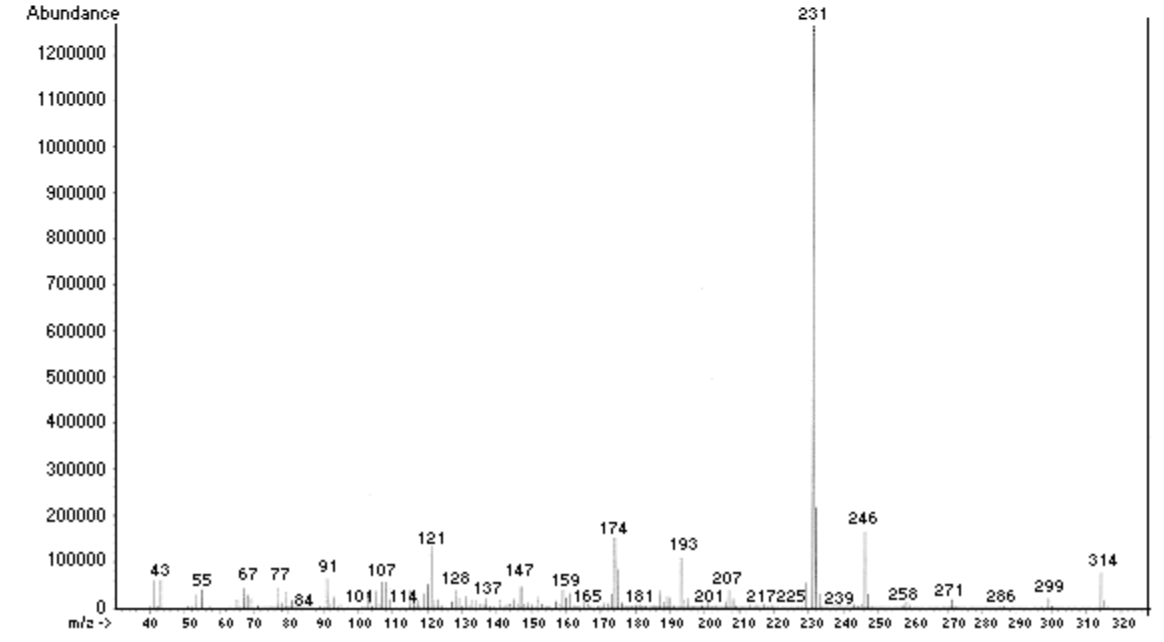

FTIR
Cannabigerol
4 scans, 4nm resolution, KBr
%T
cm-1
3428.13
2924.14
1584.09
1446.04
1146.44
1044.70


FTIR
Cannabicyclol
4 scans, 4nm resolution, KBr
%T
cm-1
3363.40
2952.19
2928.56
2866.95
1621.96
1583.18
1512.26
1422.70
1377.30
1333.03
1295.36
1259.51
1184.63
1137.37
1104.71
1077.51
1043.75
1032.37
1000.51
905.63
830.08
699.17

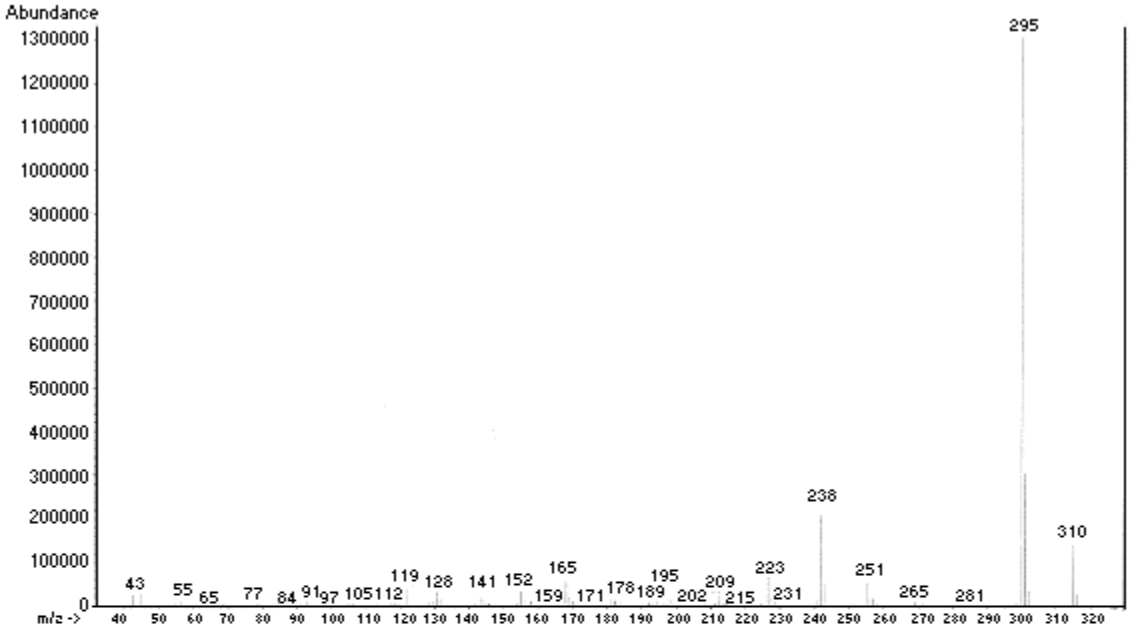
Mass Spectrometry
Δ-9-Tetrahydrocannabinol



Mass Spectrometry
Cannabidiol



Mass Spectrometry
Cannabinol



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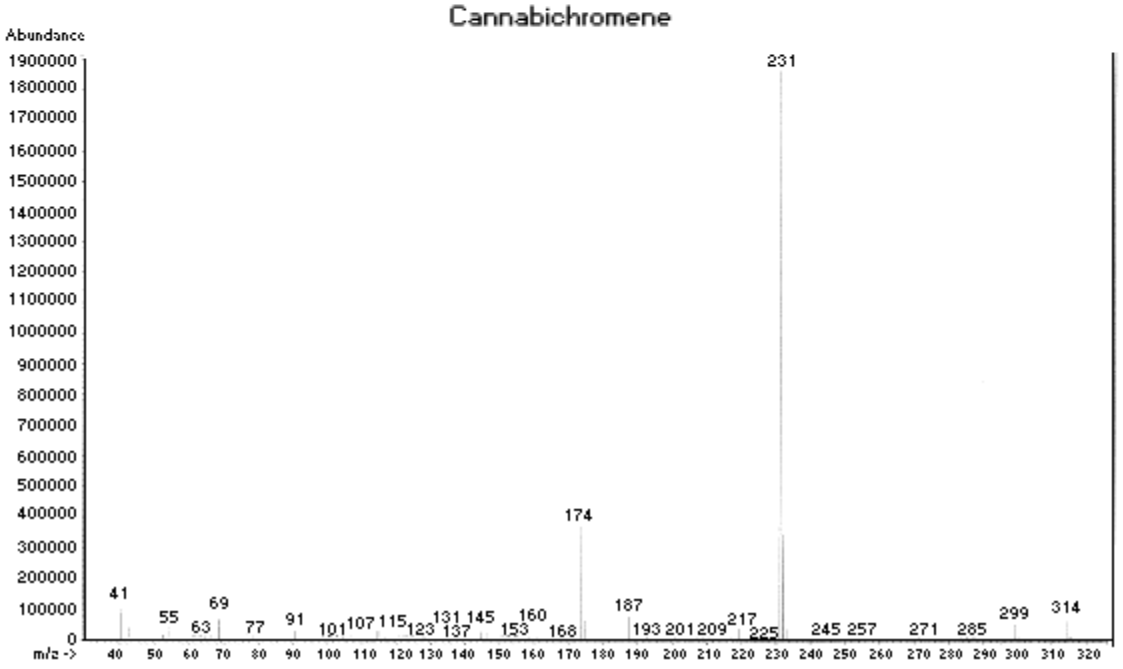
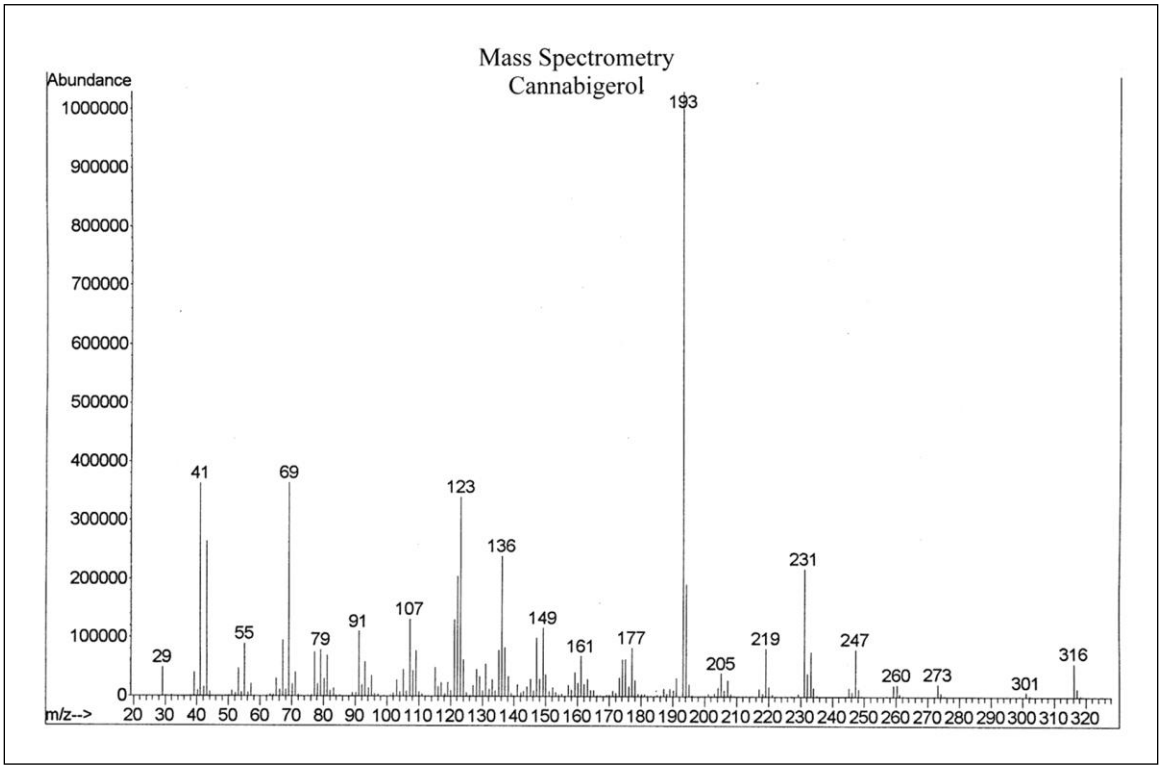
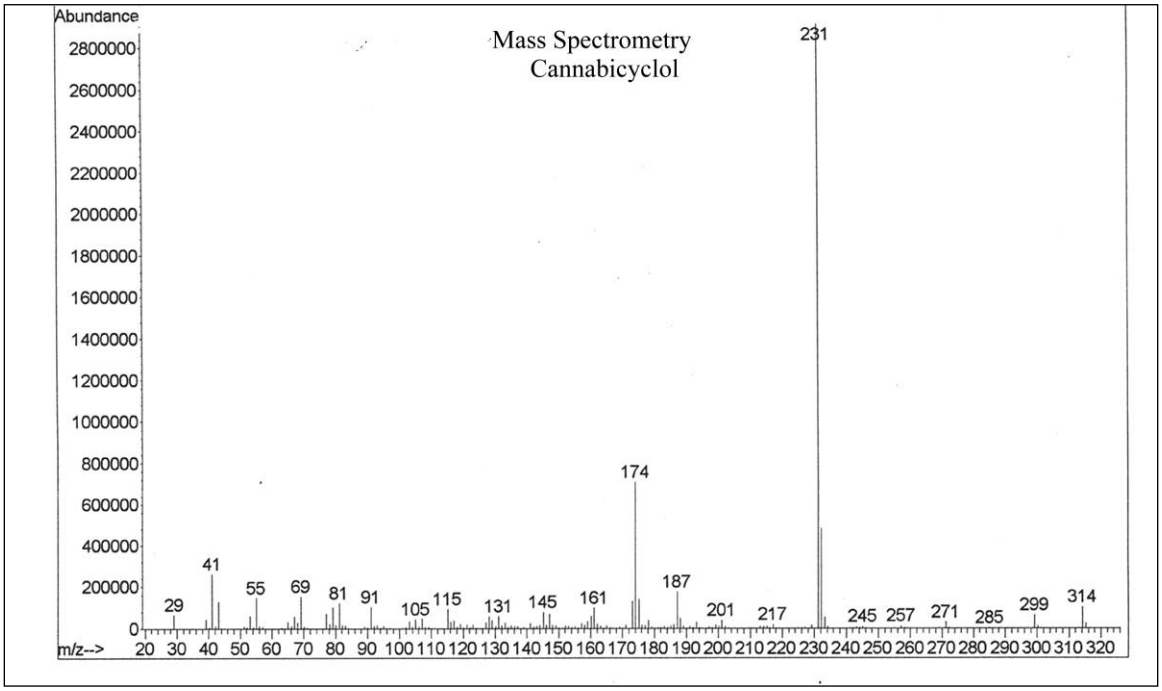
Cannabichromene




Mass Spectrometry
Cannabigerol
Abundance
m/z-->


Mass Spectrometry
Cannabicyclol
Abundance
m/z-->

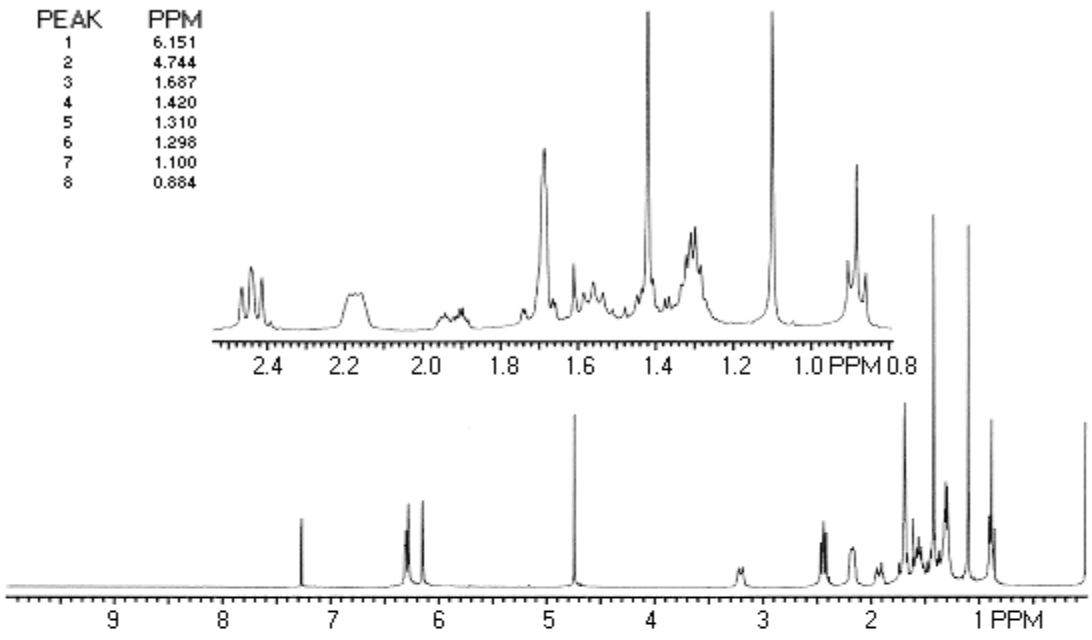
Nuclear Magnetic Resonance (proton)

Δ-9-Tetrahydrocannabinol

10 mg/mL in $CDCL_3$ with TMS

300 MHz

PEAK	PPM
1	6.151
2	4.744
3	1.687
4	1.420
5	1.310
6	1.298
7	1.100
8	0.884



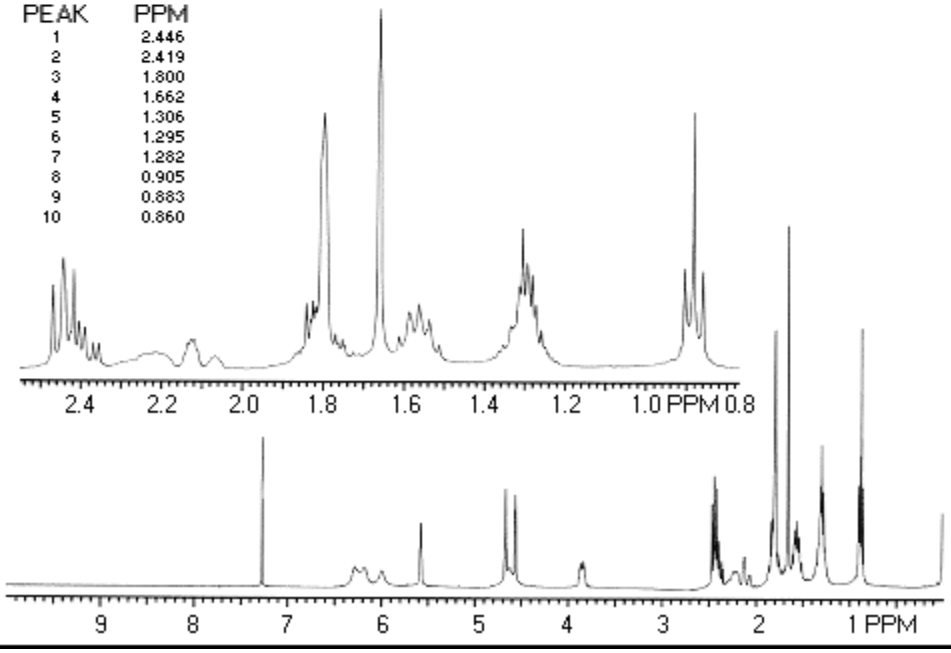
Nuclear Magnetic Resonance (proton)

Cannabidiol

10 mg/mL in $CDCL_3$ with TMS

300 MHz

PEAK	PPM
1	2.446
2	2.419
3	1.800
4	1.662
5	1.306
6	1.295
7	1.282
8	0.905
9	0.883
10	0.860



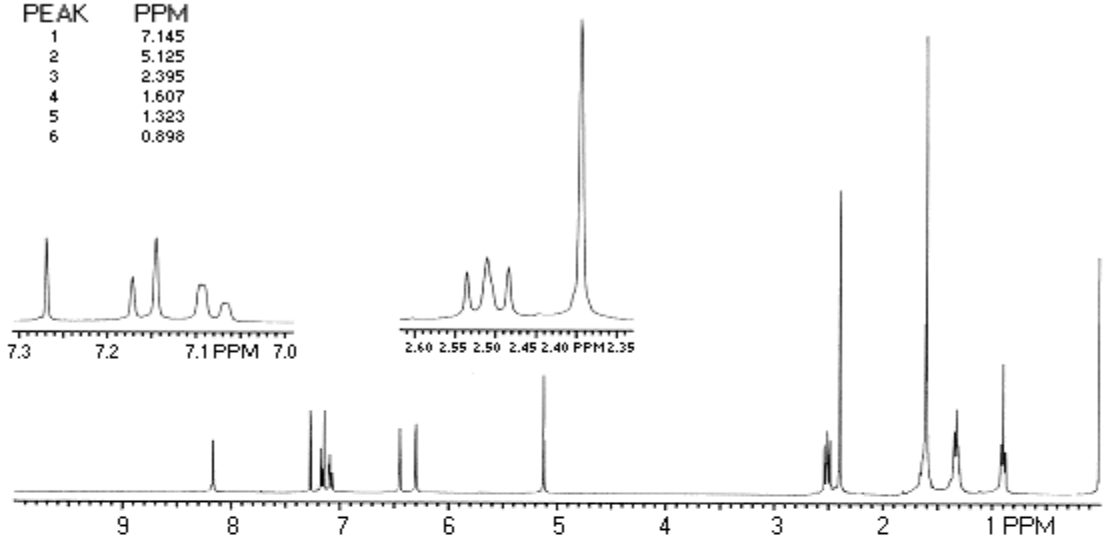
Nuclear Magnetic Resonance (proton)

Cannabinol

10 mg/mL in $CDCL_3$ with TMS

300 MHz

PEAK	PPM
1	7.145
2	5.125
3	2.395
4	1.607
5	1.323
6	0.898



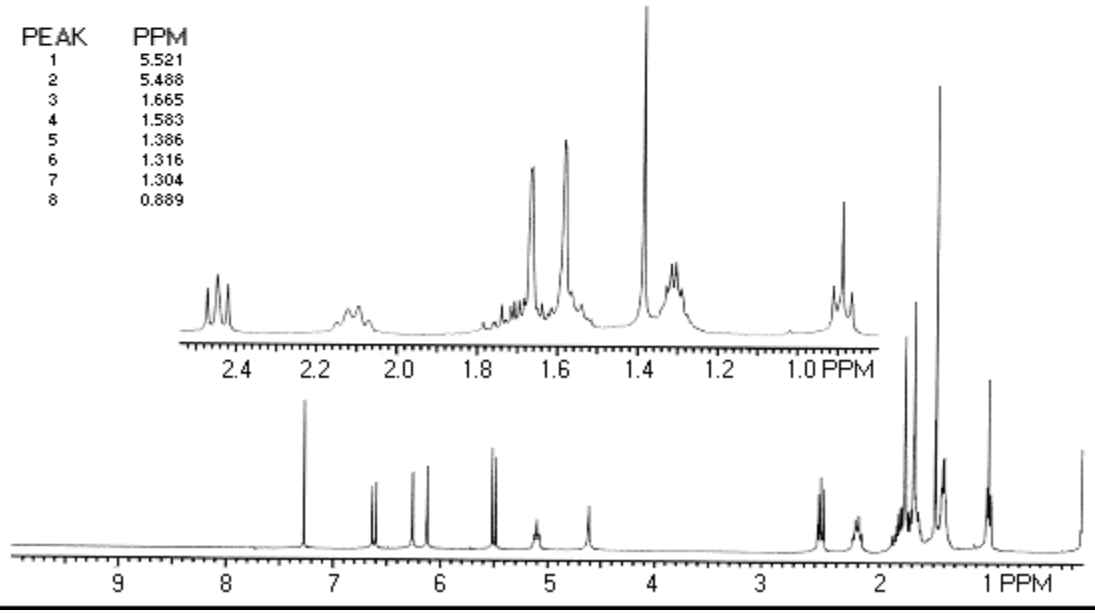
Nuclear Magnetic Resonance (proton)

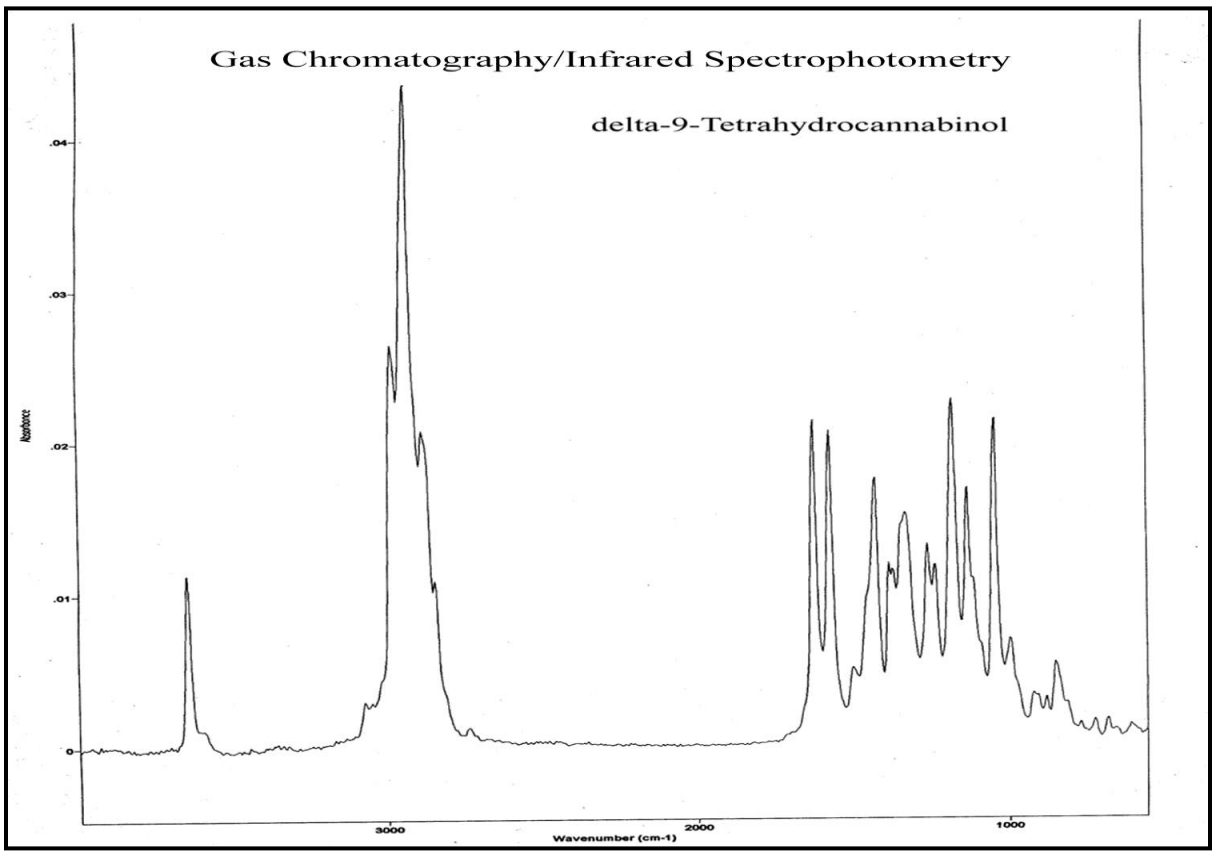
Cannabichromene

10 mg/mL in $CDCL_3$ with TMS

300 MHz

PEAK	PPM
1	5.521
2	5.488
3	1.665
4	1.583
5	1.386
6	1.316
7	1.304
8	0.889

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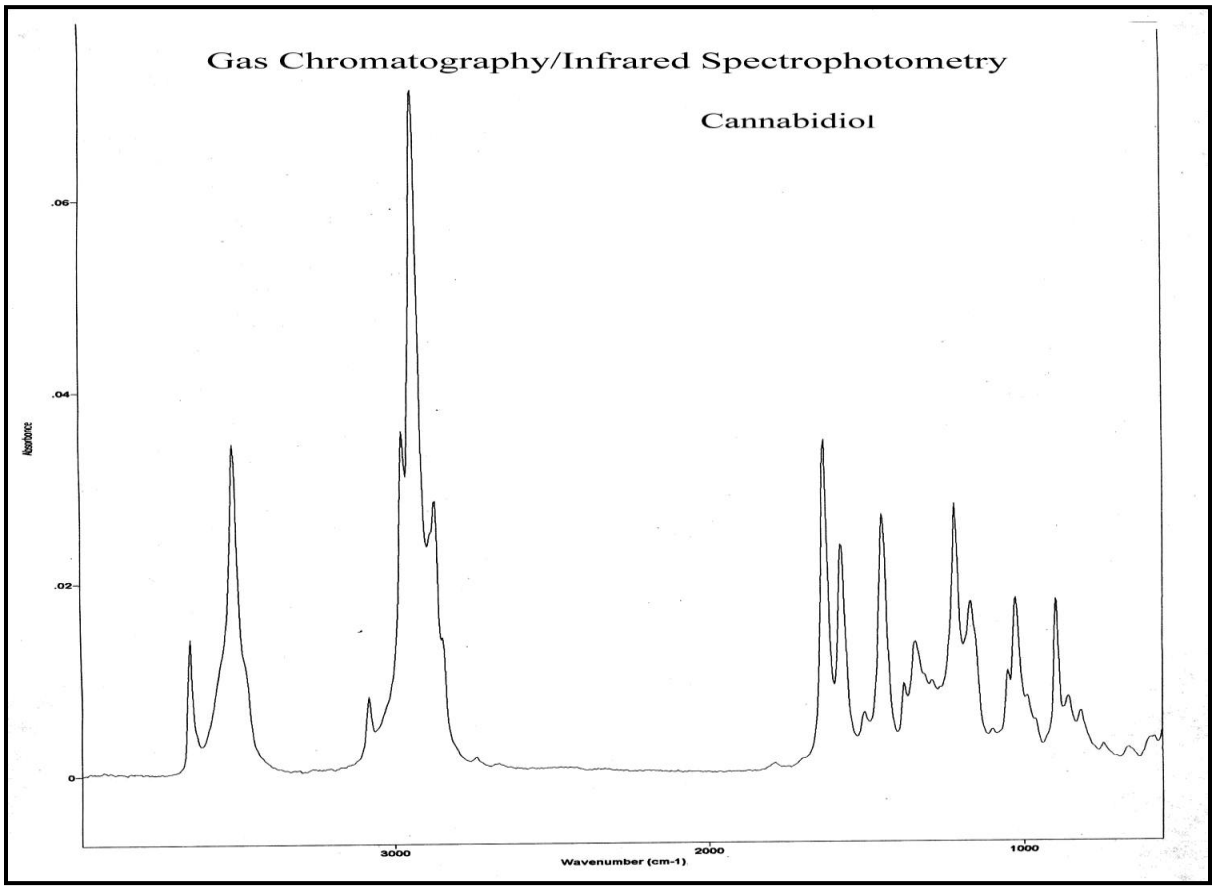
delta-9-Tetrahydrocannabinol
Absorbance
.04
.03
.02
.01
0
3000
2000
1000
Wavenumber (cm-1)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Cannabidiol
Absorbance
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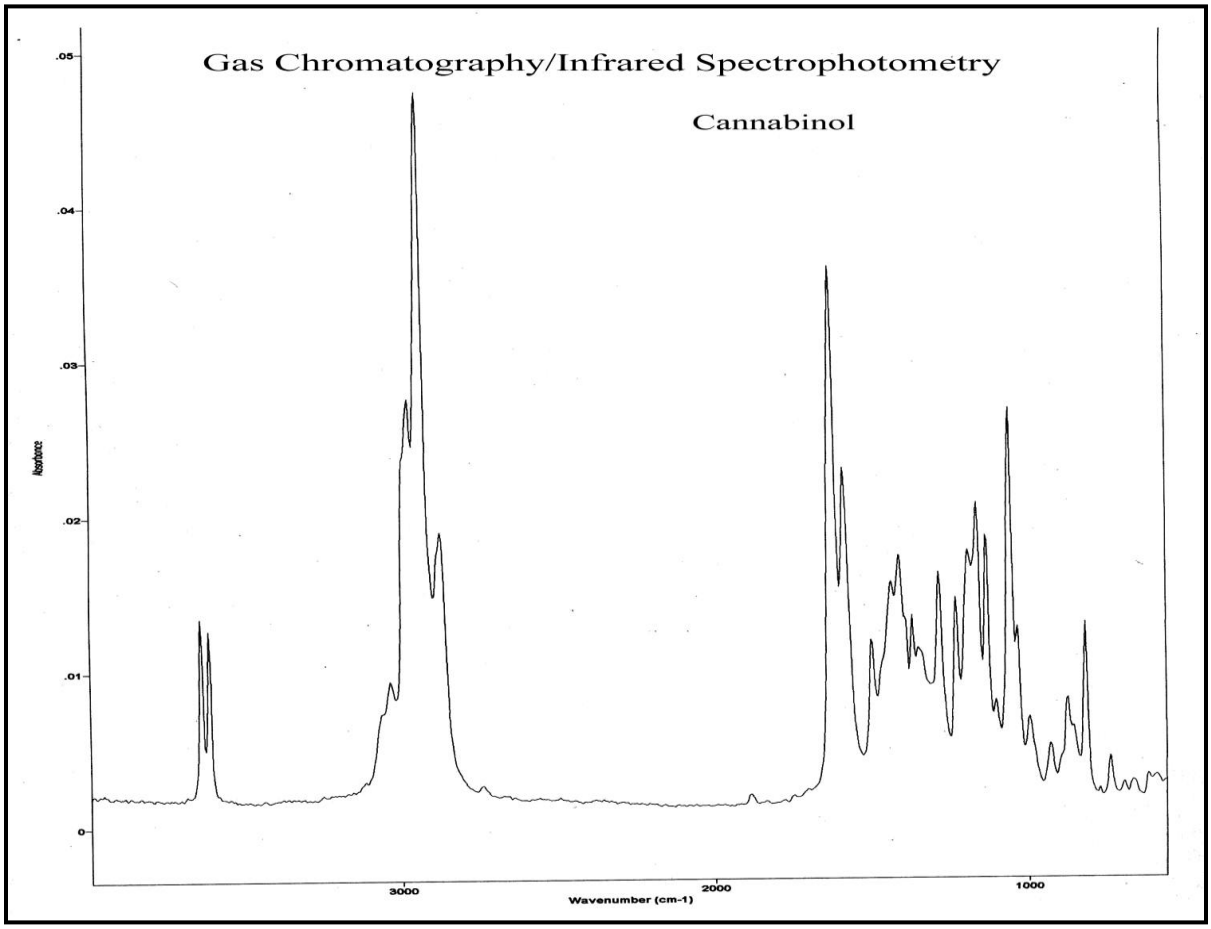
0
3000
2000
1000
Wavenumber (cm-1)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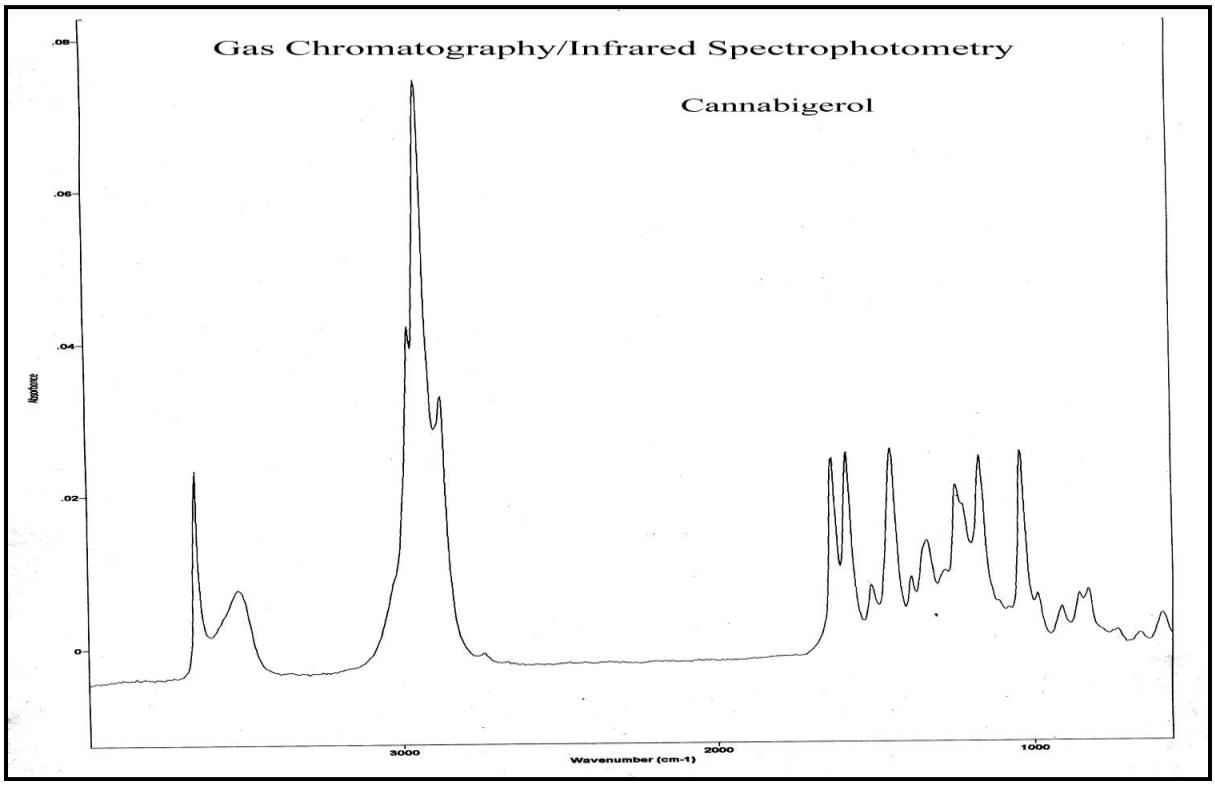
.03
.02
.01
0
Absorbance
3000
2000
1000
Wavenumber (cm-1)


Gas Chromatography/Infrared Spectrophotometry
Cannabigerol
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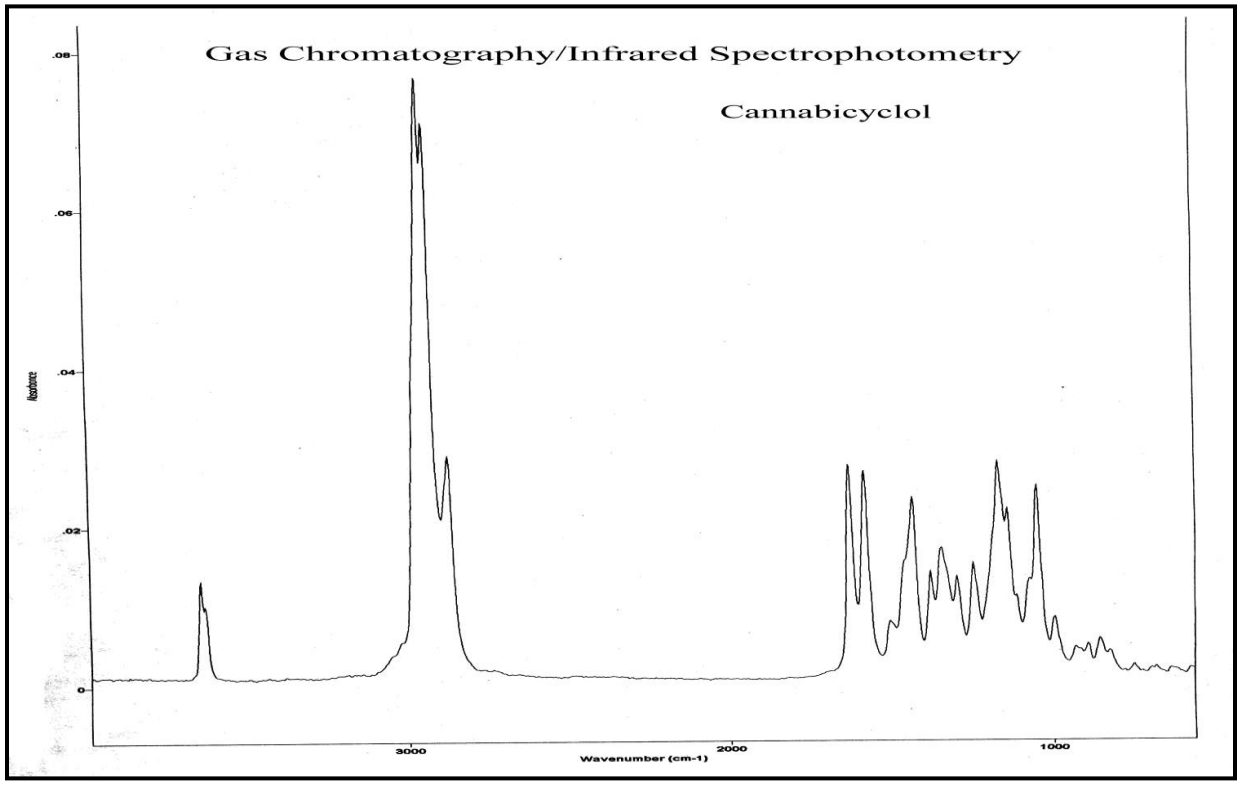
.06
.04
.02
0
Absorbance
3000
2000
1000
Wavenumber (cm-1)


Gas Chromatography/Infrared Spectrophotometry
Cannabicyclol
.08
.06
.04
.02
0
Absorbance
3000
2000
1000
Wavenumber (cm-1)