

Palladium-Catalyzed Oxidative Tandem Reaction of Allylamines with Aryl Halides Leading to α,β -Unsaturated Aldehydes

Tao-Shan Jiang and Jin-Heng Li*

^a College of Chemistry and Materials Science, Wenzhou University, Wenzhou, 325035, China. Fax: 0086731 8872 101; Tel: 0086731 8872 576; E-mail: jhli@hunnu.edu.cn

^b Key Laboratory of Chemical Biology & Traditional Chinese Medicine Research (Ministry of Education), Hunan Normal University, Changsha 410081, China.

jhli@hunnu.edu.cn

Supporting Information

List of Contents

(A) Typical Experimental Procedure	S2
(B) Analytical Data for 3-15	S2-S7
(C) References	S7-S8
(D) Spectra	S9-34

(A) Typical Experimental Procedure

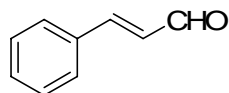
(a) Remark

Chemicals were either purchased or purified by standard techniques. ^1H NMR and ^{13}C NMR spectra were measured on a 300 MHz spectrometer (^1H : 300 MHz, ^{13}C : 75 MHz), using CDCl_3 as the solvent with tetramethylsilane (TMS) as an internal standard at room temperature. Chemical shifts are given in δ relative to TMS, the coupling constants J are given in Hz. All reactions under nitrogen atmosphere were conducted using standard Schlenk techniques. Column chromatography was performed using EM Silica gel 60 (300-400 mesh).

(b) Typical Experimental Procedure for Pd-Catalyzed Tandem Reactions of *N*-Allylbenzenamine and Aryl halides:

A mixture of *N*-allyl-*N*-methylaniline **1** (0.25 mmol), aryl halide **2** (0.2 mmol), $\text{Pd}(\text{OAc})_2$ (0.01 mmol), PPh_3 (0.02 mmol), NaOAc (0.4 mmol), TBAB (0.2 mmol), and DMF (2 mL) was stirred under air atmosphere at 100-120 °C for the indicated time (Tables 1 and 2) until complete consumption of starting material as monitored by TLC and GC-MS analysis. After the reaction was finished, the mixture was poured into ethyl acetate, washed with brine (3×10 mL), and extracted with ethyl acetate. The combined organic layers were dried over anhydrous Na_2SO_4 and evaporated under vacuum. The residue was purified by flash column chromatography (hexane/ethyl acetate = 30:1) to afford the desired product.

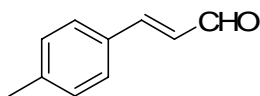
(B) Analytical Data for 3-15



Cinnamaldehyde (**3**)¹⁻³

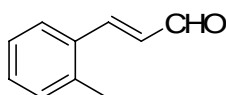
$R_f = 0.43$ (petroleum ether/EtOAc = 10:1); ^1H NMR (300 MHz, CDCl_3) δ : 9.70 (d, $J = 7.7$ Hz, 1H, -CHO), 7.58-7.55 (m, 1H, H-Ar), 7.50 (d, $J = 16.0$ Hz, 1H, =CH), 7.45-7.43 (m, 4H, H-Ar), 6.72 (dd, $J = 7.7$ Hz, $J = 16.0$ Hz, 1H, =CH); ^{13}C NMR (75

MHz, CDCl₃) δ : 193.6, 152.6, 133.9, 131.1, 129.0, 128.5, 128.4; MS (EI, 70 eV) m/z (%): 132 (M⁺, 59), 131 (100), 103 (57), 77 (51).



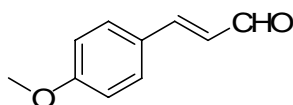
4-Methyl-cinnamaldehyde (4)³

R_f = 0.44 (petroleum ether/EtOAc = 10:1); ¹H NMR (300 MHz, CDCl₃) δ : 9.68 (d, J = 7.7 Hz, 1H, -CHO), 7.49-7.43 (m, 3H, H-Ar, =CH), 7.26-7.23 (m, 2H, H-Ar), 6.69 (dd, J = 7.7 Hz, J = 15.9 Hz, 1H, =CH), 2.40 (s, 3H, -CH₃); ¹³C NMR (75 MHz, CDCl₃) δ : 193.7, 152.9, 131.3, 129.8, 129.1, 128.5, 127.7, 21.5; MS (EI, 70 eV) m/z (%): 146 (M⁺, 17), 145 (18), 131 (100), 115 (37).



2-Methyl-cinnamaldehyde (5)^{1,3}

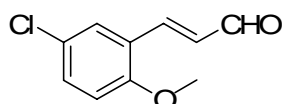
R_f = 0.44 (petroleum ether/EtOAc = 10:1); ¹H NMR (300 MHz, CDCl₃) δ : 9.73 (d, J = 7.7 Hz, 1H, -CHO), 7.78 (d, J = 15.8 Hz, 1H, =CH), 7.61-7.58 (m, 1H, H-Ar), 7.36-7.23 (m, 3H, H-Ar), 6.67 (dd, J = 7.7 Hz, J = 15.8 Hz, 1H, =CH), 2.48 (s, 3H, -CH₃); ¹³C NMR (75 MHz, CDCl₃) δ : 193.7, 150.1, 137.8, 132.7, 131.1, 130.9, 129.5, 126.7, 126.5, 19.6; MS (EI, 70 eV) m/z (%): 146 (M⁺, 21), 145 (15), 131 (100), 115 (47).



4-Methoxy-cinnamaldehyde (6)¹⁻⁴

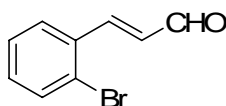
R_f = 0.23 (petroleum ether/EtOAc = 10:1); ¹H NMR (300 MHz, CDCl₃) δ : 9.66 (d, J = 7.7 Hz, 1H, -CHO), 7.53 (d, J = 8.7 Hz, 2H, H-Ar), 7.43 (d, J = 15.9 Hz, 1H,

=CH), 6.95 (d, $J = 8.7$ Hz, 2H, H-Ar), 6.61 (dd, $J = 7.7$ Hz, $J = 15.9$ Hz, 1H, =CH), 3.86 (s, 3H, -OCH₃); ¹³C NMR (75 MHz, CDCl₃) δ : 193.6, 162.1, 152.6, 130.2, 126.6, 126.4, 114.4, 55.3; MS (EI, 70 eV) m/z (%): 162 (M⁺, 100), 161 (60), 131 (53).



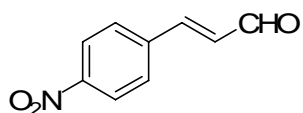
5-Chloro-2-methoxy-cinnamaldehyde (7)⁷

$R_f = 0.32$ (petroleum ether/EtOAc = 10:1); ¹H NMR (300 MHz, CDCl₃) δ : 9.69 (d, $J = 7.8$ Hz, 1H, -CHO), 7.74 (d, $J = 16.1$ Hz, 1H, =CH), 7.50 (s, 1H, H-Ar), 7.35 (d, $J = 8.9$ Hz, 1H, H-Ar), 6.88 (d, $J = 8.9$ Hz, 1H, H-Ar), 6.75 (dd, $J = 7.8$ Hz, $J = 16.1$ Hz, 1H, =CH), 3.89 (s, 3H, -OCH₃); ¹³C NMR (75 MHz, CDCl₃) δ : 194.1, 156.7, 146.3, 131.9, 129.9, 128.2, 125.9, 124.3, 112.6, 55.9; MS (EI, 70 eV) m/z (%): 196 (M⁺, 28), 165 (100), 125 (58), 89 (64).



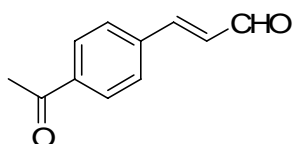
2-Bromo-cinnamaldehyde (8)⁵

$R_f = 0.49$ (petroleum ether/EtOAc = 10:1); ¹H NMR (300 MHz, CDCl₃) δ : 9.77 (d, $J = 7.7$ Hz, 1H, -CHO), 7.90 (d, $J = 15.9$ Hz, 1H, =CH), 7.67-7.64 (m, 2H, H-Ar), 7.37-7.30 (m, 1H, H-Ar), 7.28-7.26 (m, 1H, H-Ar), 6.67 (dd, $J = 7.7$ Hz, $J = 15.9$ Hz, 1H, =CH); ¹³C NMR (75 MHz, CDCl₃) δ : 193.4, 150.5, 133.8, 133.6, 132.1, 130.7, 128.0, 127.9, 125.7; MS (EI, 70 eV) m/z (%): 212 (M⁺ + 2, 4), 210 (M⁺, 4), 131 (100), 103 (34).



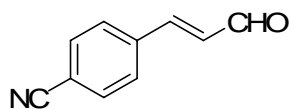
4-Nitro-cinnamaldehyde (9)¹⁻³

$R_f = 0.23$ (petroleum ether/EtOAc = 5:1); $^1\text{H NMR}$ (300 MHz, CDCl_3) δ : 9.78 (d, $J = 7.4$ Hz, 1H, -CHO), 8.30 (d, $J = 8.7$ Hz, 2H, H-Ar), 7.75 (d, $J = 8.7$ Hz, 2H, H-Ar), 7.55 (d, $J = 16.1$ Hz, 1H, =CH), 6.82 (dd, $J = 7.4$ Hz, $J = 16.1$ Hz, 1H, =CH); $^{13}\text{C NMR}$ (75 MHz, CDCl_3) δ : 192.7, 148.7, 139.8, 131.6, 128.9, 128.2, 124.2; MS (EI, 70 eV) m/z (%): 177 (M^+ , 25), 159 (100), 130 (92), 77 (94).



4-Acetyl-cinnamaldehyde (10)^{1,3}

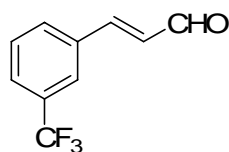
$R_f = 0.20$ (petroleum ether/EtOAc = 5:1); $^1\text{H NMR}$ (300 MHz, CDCl_3) δ : 9.75 (d, $J = 7.6$ Hz, 1H, -CHO), 8.02 (d, $J = 8.4$ Hz, 2H, H-Ar), 7.67 (d, $J = 8.4$ Hz, 2H, H-Ar), 7.53 (d, $J = 16.0$ Hz, 1H, =CH), 6.79 (dd, $J = 7.6$ Hz, $J = 16.0$ Hz, 1H, =CH). 2.65 (s, 3H, -CH₃); $^{13}\text{C NMR}$ (75 MHz, CDCl_3) δ : 197.1, 193.2, 150.5, 138.5, 138.0, 130.3, 128.8, 128.4, 26.6; MS (EI, 70 eV) m/z (%): 174 (M^+ , 90), 159 (74), 131 (100), 103 (70).



4-Cyano-cinnamaldehyde (11)^{1,3,4}

$R_f = 0.22$ (petroleum ether/EtOAc = 5:1); $^1\text{H NMR}$ (300 MHz, CDCl_3) δ : 9.75 (d, $J = 7.5$ Hz, 1H, -CHO), 7.72 (d, $J = 8.5$ Hz, 2H, H-Ar), 7.66 (d, $J = 8.5$ Hz, 2H, H-Ar), 7.48 (d, $J = 16.1$ Hz, 1H, =CH), 6.76 (dd, $J = 7.5$ Hz, $J = 16.1$ Hz, 1H, =CH); $^{13}\text{C NMR}$

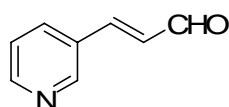
(75 MHz, CDCl₃) δ : 192.9, 149.4, 138.1, 132.8, 131.1, 128.7, 118.1, 114.2; MS (EI, 70 eV) m/z (%): 157 (M⁺, 71), 156 (100), 129 (63), 128 (65);



3-Trifluoromethyl-cinnamaldehyde (12)³

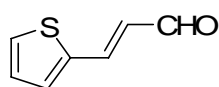
R_f = 0.37 (petroleum ether/EtOAc = 10:1); ¹H NMR (300 MHz, CDCl₃) δ : 9.75 (d, J = 7.5 Hz, 1H, -CHO), 7.81 (s, 1H, H-Ar), 7.76 (d, J = 7.8 Hz, 1H, H-Ar), 7.70 (d, J = 7.8 Hz, 1H, H-Ar), 7.58-7.55 (m, 1H, H-Ar), 7.50 (d, J = 16.0 Hz, 1H, =CH), 6.78 (dd, J = 7.5 Hz, J = 16.0 Hz, 1H, =CH); ¹³C NMR (75 MHz, CDCl₃) δ : 192.9, 150.2, 134.8, 131.1, 130.0, 129.7, 127.5, 127.4, 127.2 (q, J_{C-F} = 270.7 Hz), 125.1;

MS (EI, 70 eV) m/z (%): 200 (M⁺, 7), 199 (19), 151 (51), 131 (100).



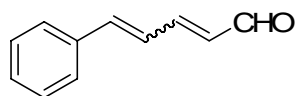
(E)-3-(Pyridin-3-yl)acrylaldehyde (13)^{2,4}

R_f = 0.20 (2:1 petroleum ether/EtOAc). ¹H NMR (300 MHz, CDCl₃) δ : 9.72 (d, J = 7.5 Hz, 1H, -CHO), 8.77 (s, 1H, H-Ar), 8.64 (s, 1H, H-Ar), 7.88 (d, J = 7.8 Hz, 1H, H-Ar), 7.48 (d, J = 16.1 Hz, 1H, =CH), 7.39-7.35 (m, 1H, H-Ar), 6.82 (dd, J = 7.5 Hz, J = 16.1 Hz, 1H, =CH); ¹³C NMR (75 MHz, CDCl₃) δ : 192.9, 151.8, 149.9, 148.3, 134.4, 130.2, 129.8, 123.9; MS (EI, 70 eV) m/z (%): 133 (M⁺, 60), 132 (87), 79 (78), 51 (100).



(E)-3-(Thiophen-2-yl)acrylaldehyde (14)⁶

$R_f = 0.29$ (petroleum ether/EtOAc = 10:1); $^1\text{H NMR}$ (300 MHz, CDCl_3) δ : 9.63 (d, $J = 7.7$ Hz, 1H, -CHO), 7.58 (d, $J = 15.6$ Hz, 1H, =CH), 7.50 (d, $J = 5.1$ Hz, 1H, H-Ar), 7.36 (d, $J = 3.6$ Hz, 1H, H-Ar), 7.11 (dd, $J = 3.6$ Hz, $J = 5.1$ Hz, 1H, H-Ar), 6.51 (dd, $J = 7.7$ Hz, $J = 15.6$ Hz, 1H, =CH); $^{13}\text{C NMR}$ (75 MHz, CDCl_3) δ : 192.8, 144.2, 139.2, 131.9, 130.3, 128.5, 127.4; MS (EI, 70 eV) m/z (%): 138 (M^+ , 100), 137 (26), 110 (52), 109 (55).



5-Phenylpenta-2,4-dienal (15)²

$R_f = 0.36$ (petroleum ether/EtOAc = 10:1); $^1\text{H NMR}$ (300 MHz, CDCl_3) δ : 9.62 (d, $J = 7.9$ Hz, 1H, -CHO), 7.52-7.49 (m, 2H, H-Ar), 7.41-7.37 (m, 3H, H-Ar), 7.28-7.26 (m, 1H, =CH), 7.03-7.00 (m, 2H, =CH), 6.28 (dd, $J = 7.9$ Hz, $J = 15.2$ Hz, 1H, =CH); $^{13}\text{C NMR}$ (75 MHz, CDCl_3) δ : 193.5, 151.9, 142.4, 135.6, 131.6, 129.6, 128.9, 127.5, 126.2; MS (EI, 70 eV) m/z (%): 158 (M^+ , 51), 157 (17), 129 (100), 128 (69).

References

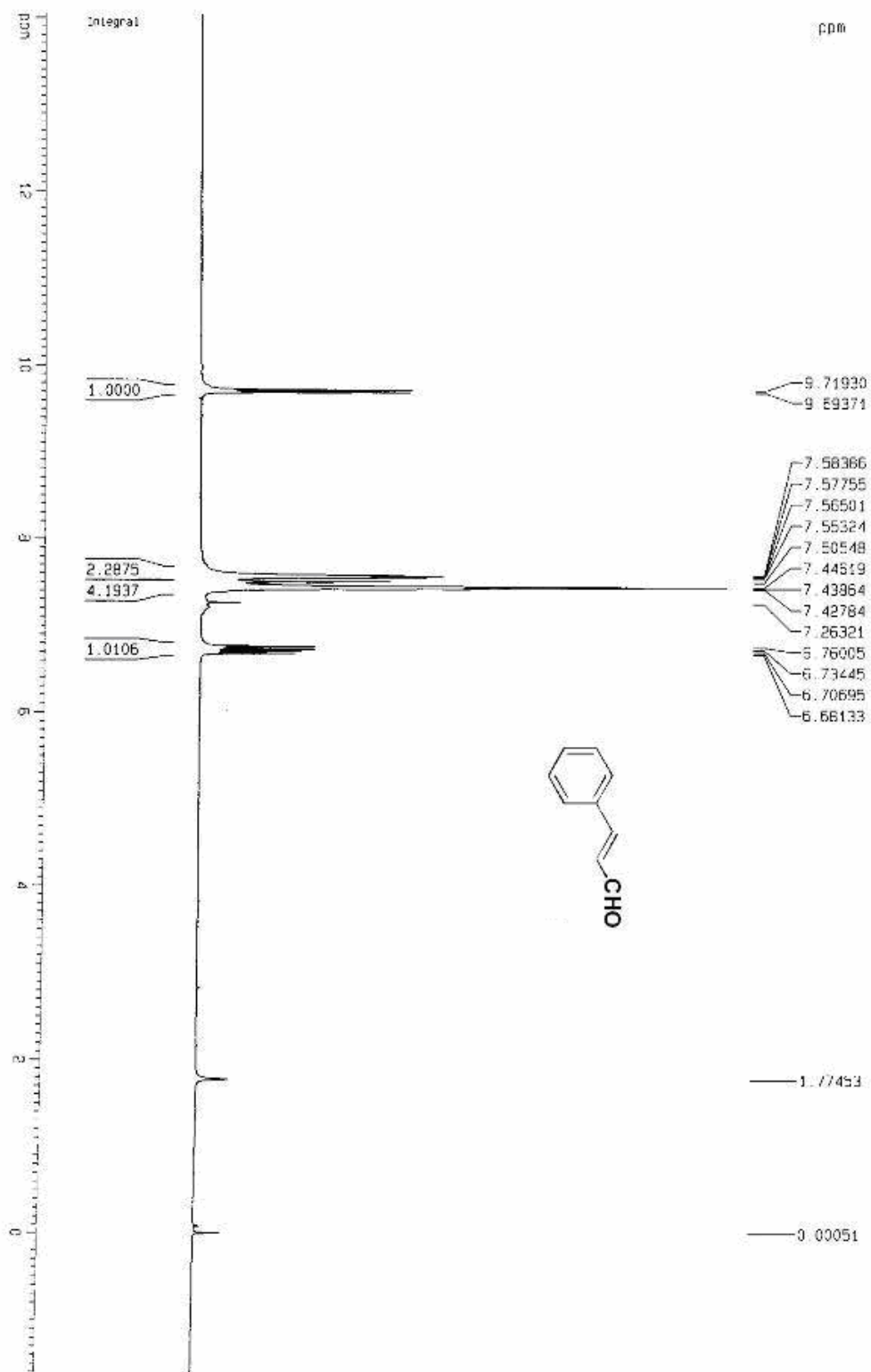
- (1) Zhu, J.; Liu, J.; Ma, R.; Xie, H.; Li, J.; Jiang, H.; Wang, W. *Adv. Synth. Catal.* **2009**, *351*, 1229.
- (2) Reid, M.; Roweb, D. J.; Taylor, R. J. *Chem. Commun.* **2003**, 2284.
- (3) Battistuzzi, G.; Cacchi, S.; Fabrizi, G. *Org. Lett.* **2003**, *5*, 777.
- (4) Alacid, E.; Nájera, C. *Eur. J. Org. Chem.* **2008**, 3102.
- (5) Daubresse, N.; Francesch, C.; Rolando, C. *Tetrahedron* **1998**, 10761.

(6) Cadierno, V.; Francos, J.; Gimeno, J. *Tetrahedron Lett.* **2009**, 4773

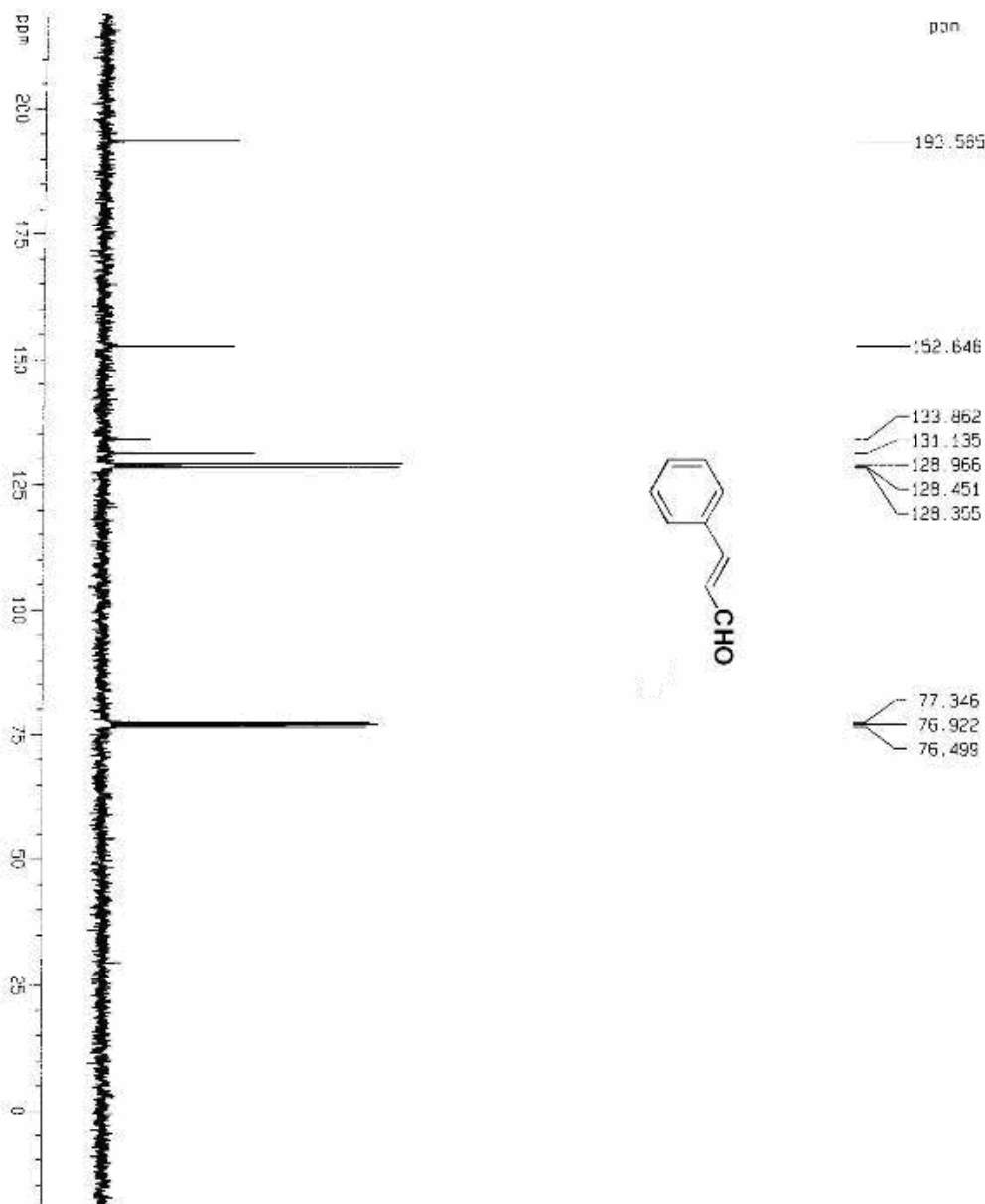
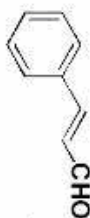
(7) Billman, J. H.; Tonnis, J. A. *J Pharm Sci.* **1971**. 1188

(D) Spectra

Cinnamaldehyde (3)



Cinnamaldehyde (3)



```

Current Data Parameters
Name          16041304
EXPNO        2
PROCNO       1

F2 - Acquisition Parameters
Date_         20080412
Time         21.45
INSTRUM      spect
PROBHD       5 mm PABBO BB-
PULPROG      zgpg30
TD           65536
SOLVENT      CDCl3
NS           381
DS           0
SWH          17395.611 Hz
FIDRES       0.274423 Hz
AQ           1.8015508 sec
RG           6.00 usec
DE           16394
DA           296.1 K
TE           2.000000000 sec
D3           0.030000000 sec
DELTA        1.898999998 sec
DELTA2       0.000000000 sec
DELTA3       0.015000000 sec
WIDENR      0.015000000 sec

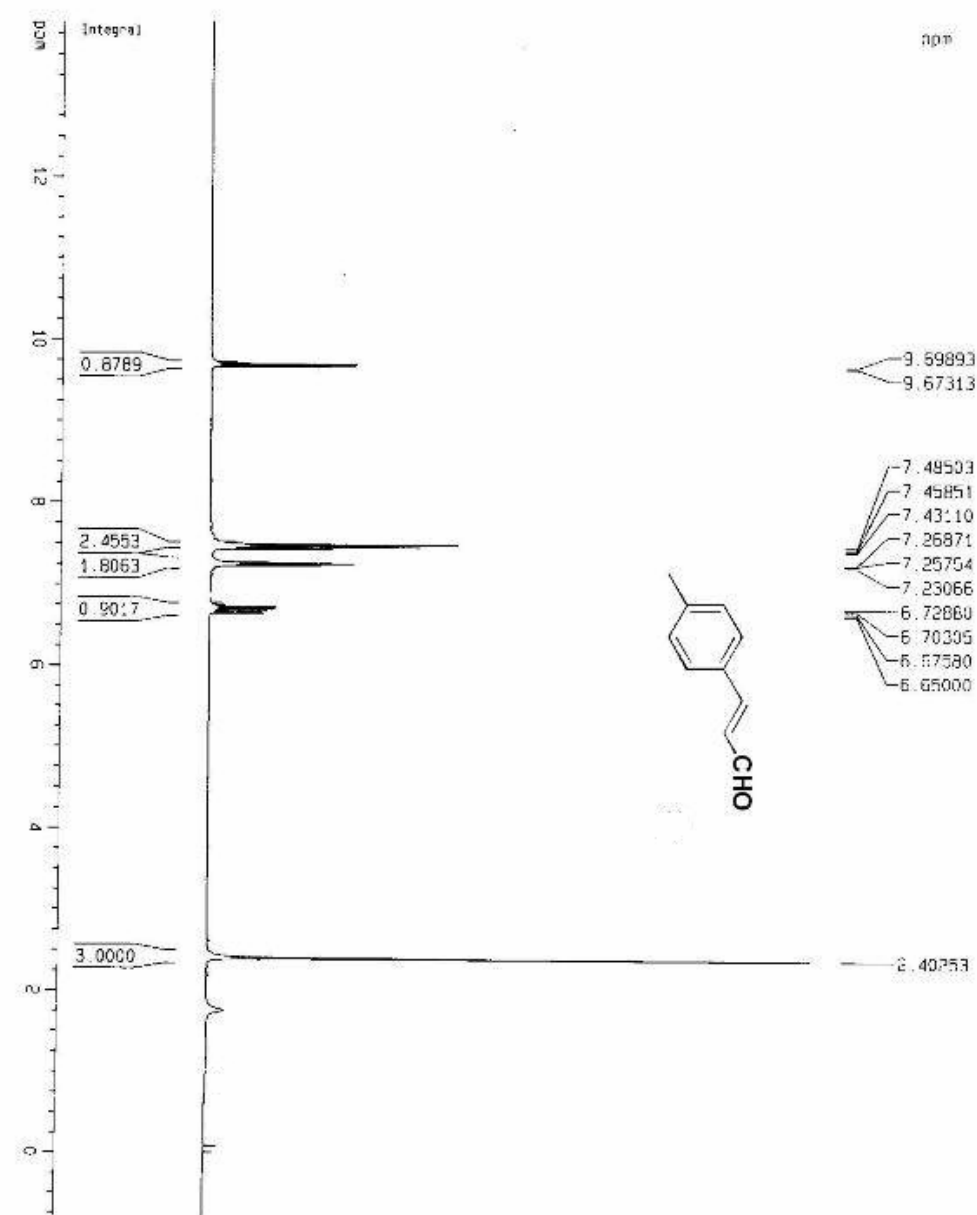
----- CHANNEL f1 -----
NUC1         13C
P1           7.80 usec
PL1         -4.00 dB
SFO1        75.4752933 MHz

----- CHANNEL f2 -----
NAME1       MALT115
NUC2         1H
P2           80.00 usec
PL2         0.00 dB
PL12        18.30 dB
PL13        18.30 dB
SFO2        300.1312905 MHz

F2 - Processing parameters
SI           32768
SF           75.467812 MHz
WDW          EM
SSB          0
GB           0
PC           3.00 usec
RC           0
IC           1.40

1D NMR 0D10 parameters
CX           20.00 cm
CY           5.00 cm
F1P         213.185 ppm
F1          16039.11 Hz
F2P         -13.167 ppm
F2          -1446.81 Hz
PREAMP     11.91009 ppm/Hz
H2O        699.28076 Hz/Hz
  
```

4-Methyl-cinnamaldehyde (4)



JLS0509001

Current Data Parameters
 NAME JLS0509001
 EXPNO 1
 PROCNO 1

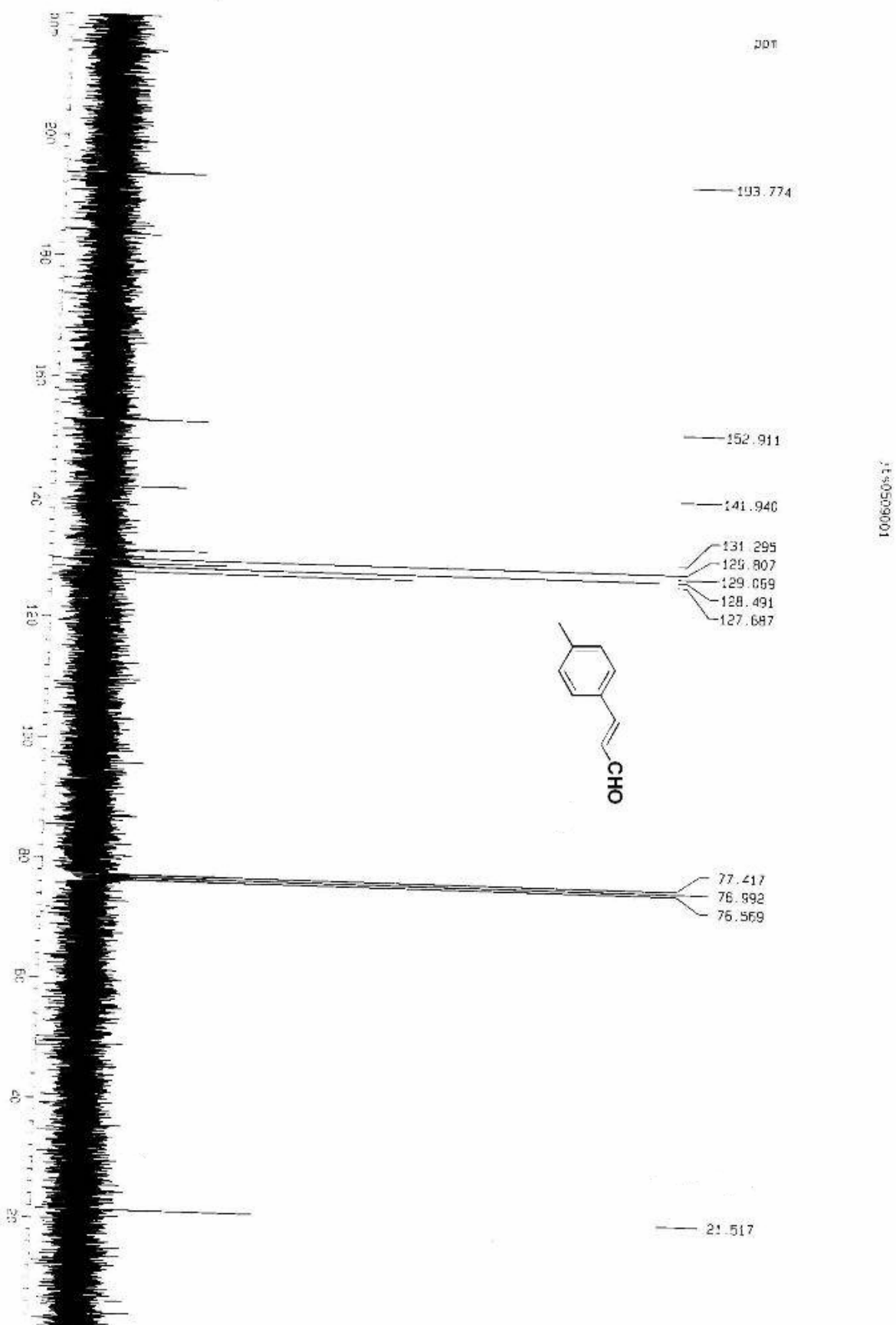
F2 - Acquisition Parameters
 Date_ 20090705
 Time 12:12
 INSTRUM dx300
 PROBHD 5 mm P4000 BBI
 PULPROG zgpg30
 TD 23880
 SOLVENT CDCl3
 NS 4
 DS 0
 SH 5950 204 Hz
 FIDRES 0.250006 Hz
 AQ 1.989820 sec
 RG 256
 DA 83.400 Usef
 TE 6.00 Usef
 DE 0.0 K
 O1 0.0000000 sec
 MCHRES1 0.0000000 sec
 NSAMP 0.01500000 sec

----- CHANNEL f1 -----
 NUC1 1H
 P1 11.00 Usef
 PL1 0.00 dB
 SFO1 300.1312913 MHz

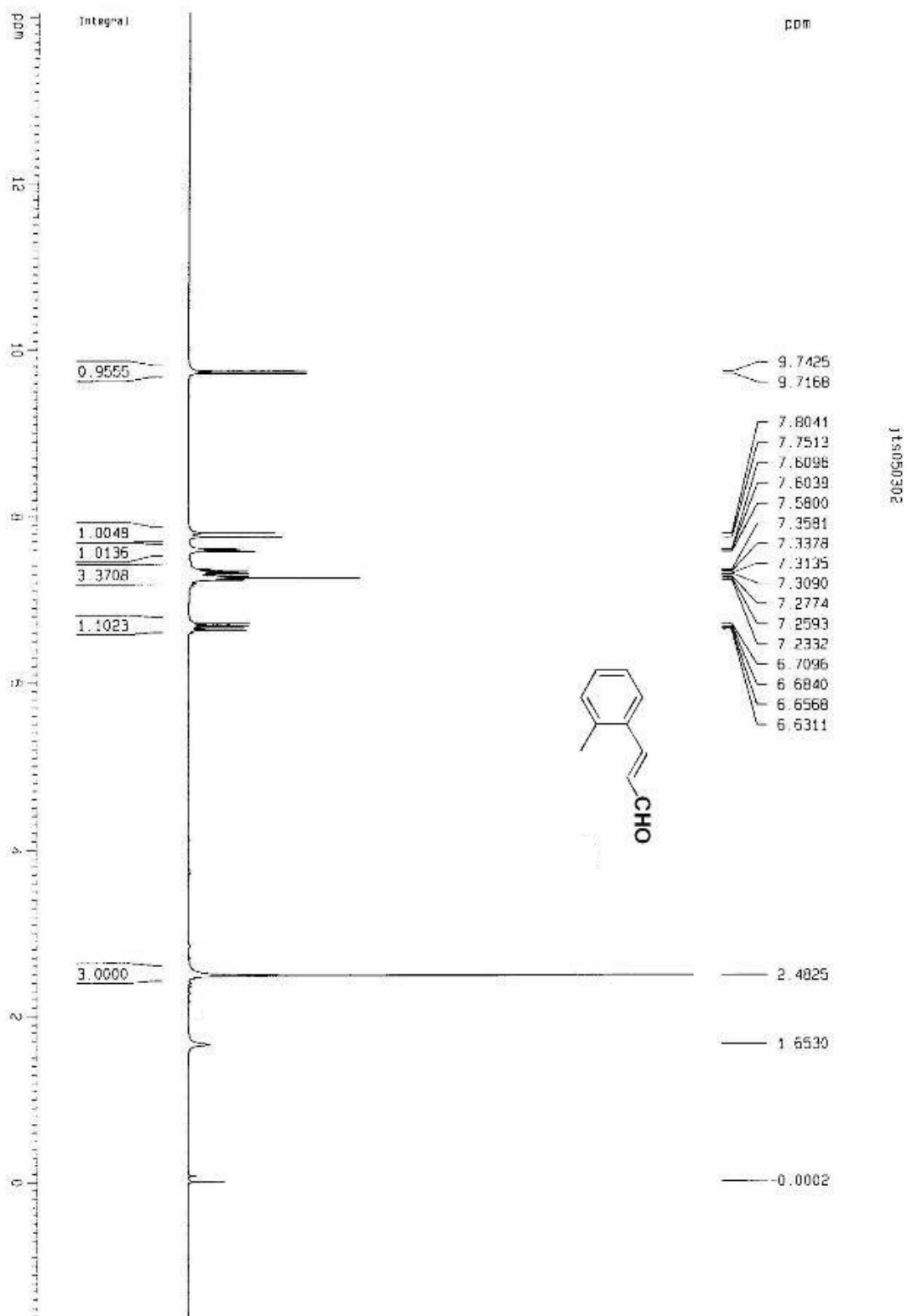
F2 - Processing Parameters
 SI 32768
 SF 300.130035 MHz
 MDW no
 SSB 0
 LB 0.00 Hz
 GB 0
 PC 1.00

ID NMR file parameters
 CX 27.00 CT
 CY 10.00 CR
 F1P 13.98750M
 F1 4173.88 Hz
 F2P -0.83250M
 F2 -249.70 Hz
 PPMX 0.72694 ppm/cm
 HZCM 321.17900 Hz/cm

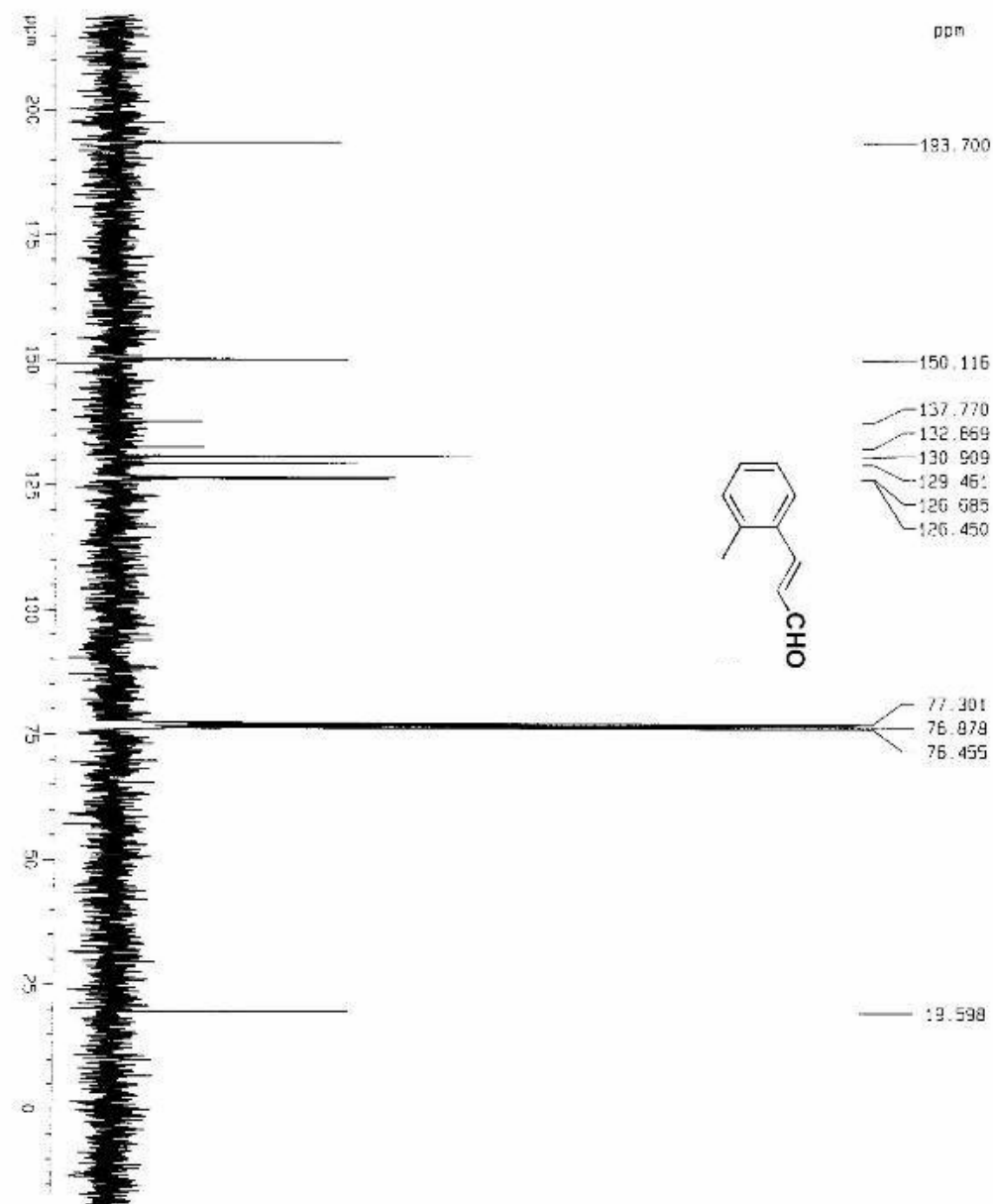
4-Methyl-cinnamaldehyde (4)



2-Methyl-cinnamaldehyde (5)



2-Methyl-cinnamaldehyde (5)

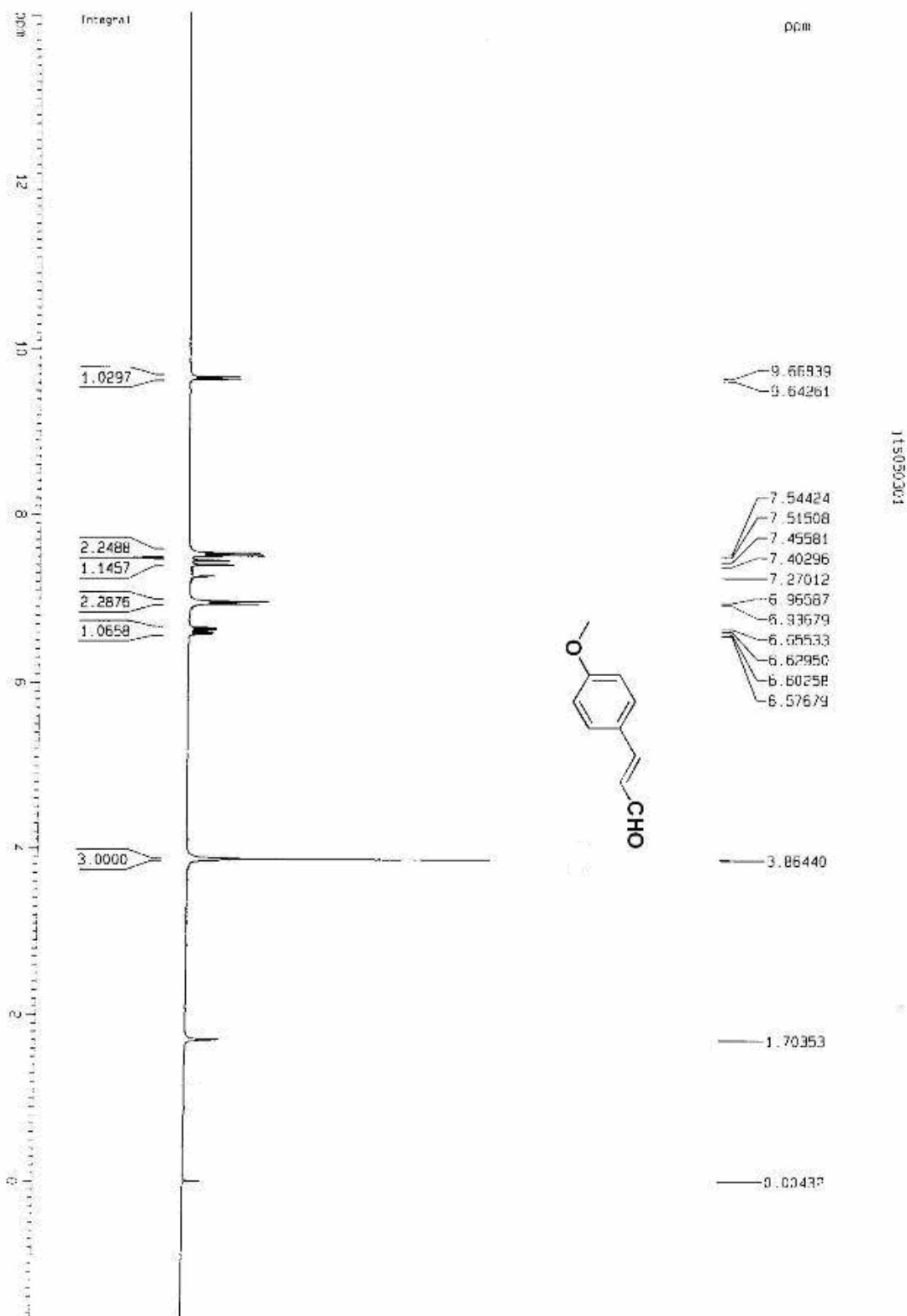


J150E0302

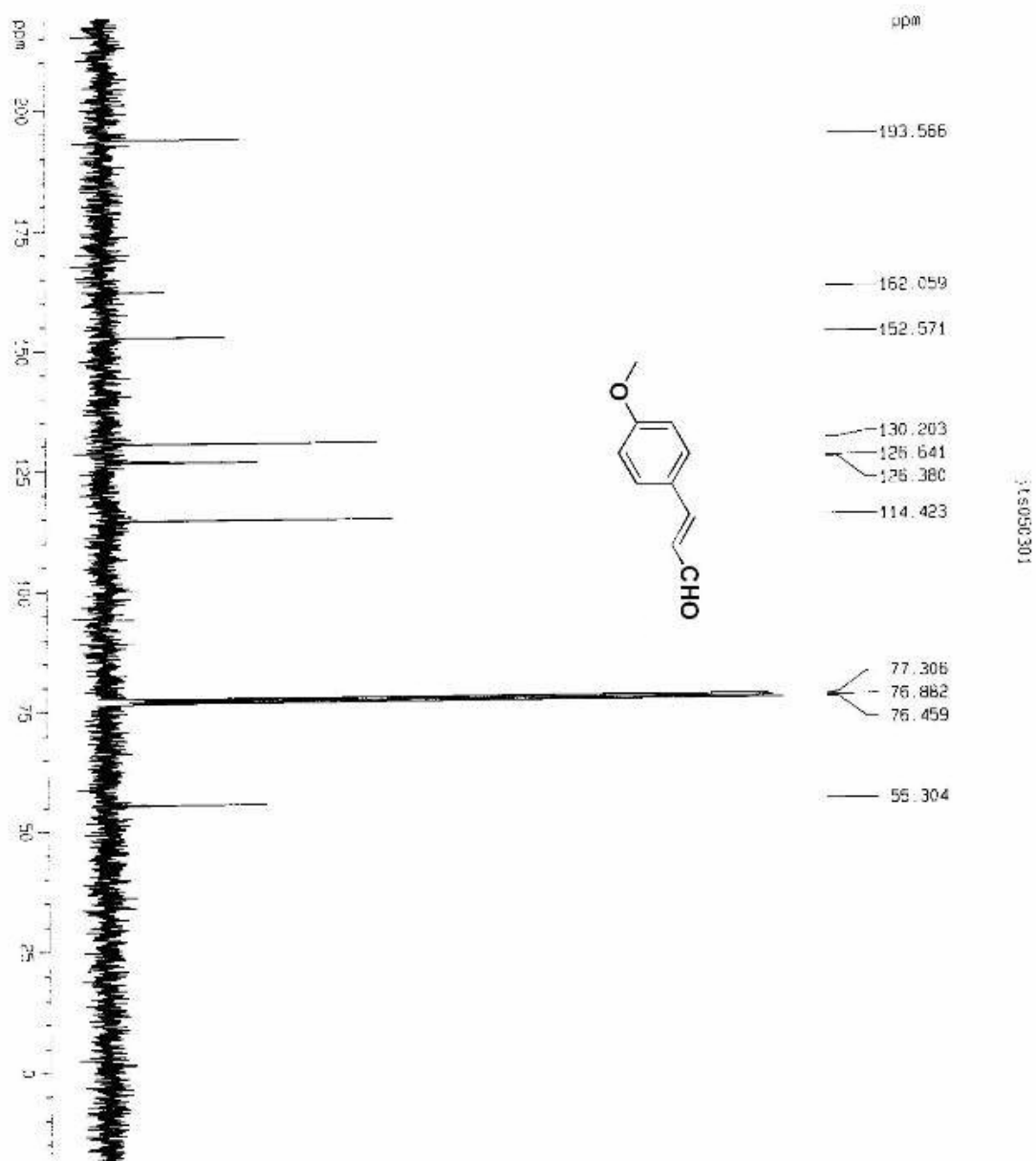
```

Current Data Parameters
NAME          J150E0302
EXPNO        2
PROCNO       1
-----
F2 - Acquisition Parameters
Date_         20080804
Time         20.39
INSTRUM      spect
PROBHD       5 mm PABBO BB
PULPROG      zgpg30
TD            65536
SOLVENT      CDCl3
NS           621
DS           4
SWH           1.9891011 Hz
FIDRES       0.274428 Hz
AQ           1.6679508 sec
RG           15384
SM           27.800 usec
AQ           15384
SM           27.800 usec
TE           298.2 K
C11         2.0000000 sec
C12         0.0300000 sec
C13         1.8999999 sec
DELTA       0.0000000 sec
NUC1        13C
NUC2        13C
PCPRG1      zgpg30
PCPRG2      0.0150000 sec
-----
***** CHANNEL f1 *****
NUC1         13C
P1           7.00 usec
PL1         -4.00 dB
SFO1         75.4752803 MHz
-----
***** CHANNEL f2 *****
OPRG1       mzgpg30
NUC2         1H
PCPD2       60.00 usec
PL2         0.00 dB
PL12        18.00 dB
PL13        18.00 dB
SFO2        300.1312805 MHz
-----
F2 - Processing parameters
SI           32768
SF           75.4677657 MHz
SOLVENT      CDCl3
SSB          0
LB           3.00 Hz
GB           0
PC           1.46
-----
1D 1Hq 2Dhq parameters
CX           20.00 sec
CY           6.00 sec
F1F2        219.125 MHz
F2          180.911 MHz
F2F1        19.167 MHz
F2          -1466.51 Hz
PRGFM       j1 2d1hqp 000/c3
H2DM       650 28000 Hz/cm
  
```

4-Methoxy-cinnamaldehyde (6)



4-Methoxy-cinnamaldehyde (6)

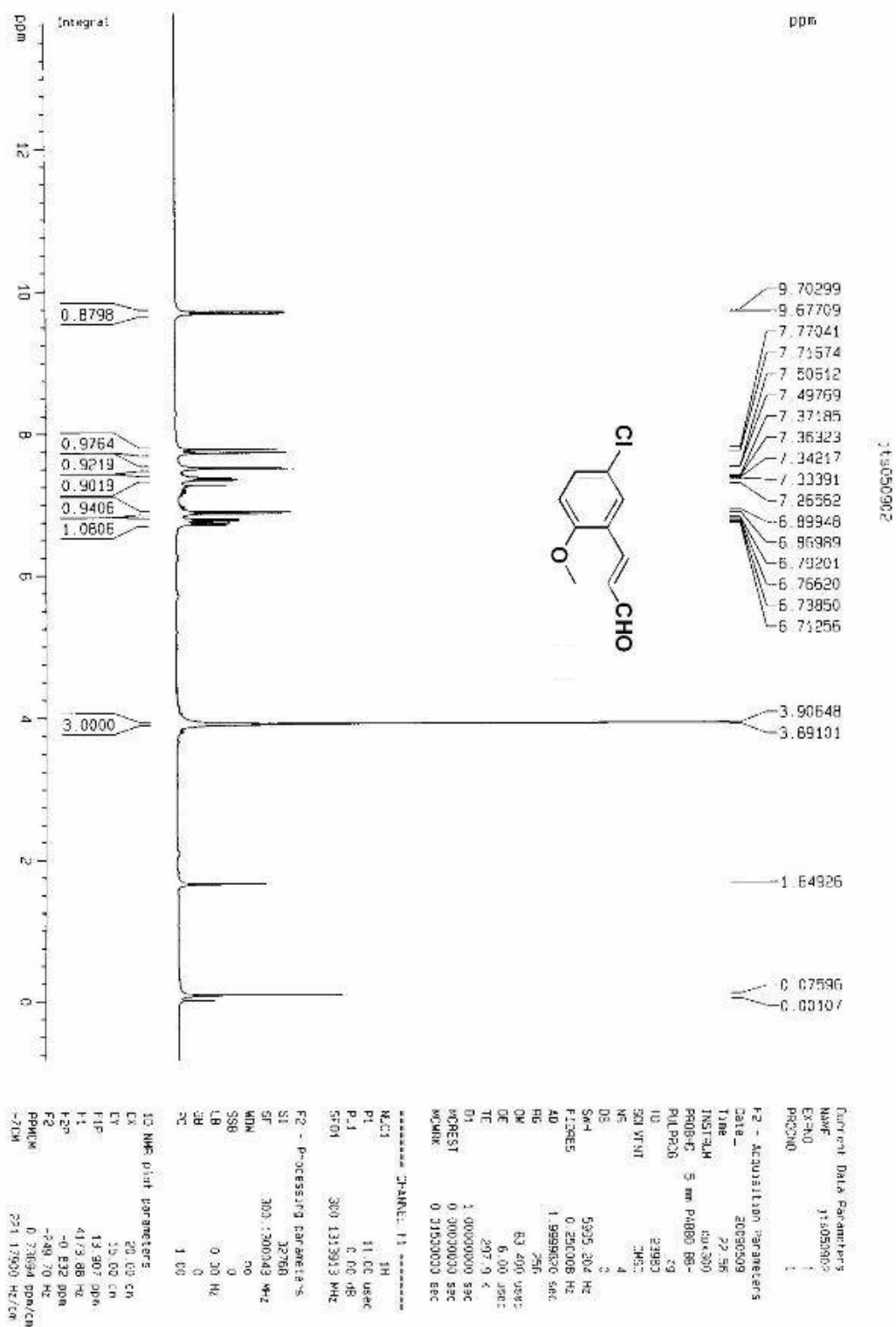


```

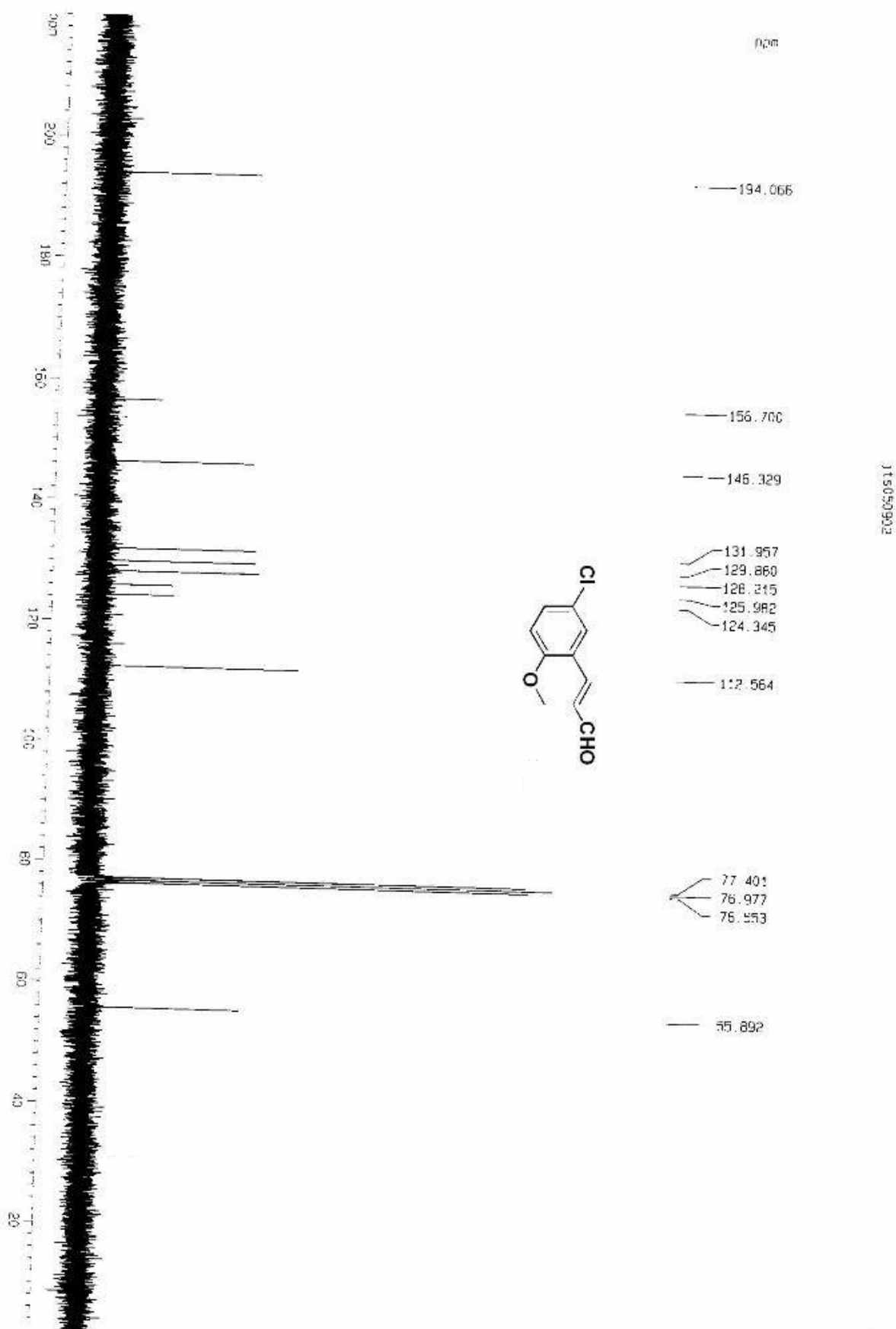
=====
F2 - Acquisition Parameters
Date_         20090603
Time_         19.42
INSTRUM      dir-300
PROBHD      5 mm PABBO 9H-
PULPROG      zgpg30
TD           65536
SOLVENT      CDCl3
NS           57
DS           0
SWH           17965.611 Hz
FIDRES       0.274439 Hz
AQ           1.8243506 sec
RG           15264
GW           37.690 usec
DE           5.00 usec
TE           298.4 K
D1           2.00000000 sec
d11          0.03000000 sec
DELTA        1.69999998 sec
WDESS1       0.00000000 sec
WDESS2       0.01500000 sec
=====
===== CHANNEL f1 =====
NUC1          13C
P1            7.00 usec
PL1          -4.00 dB
RF1           75.4752653 MHz
SFO1          200.1322005 MHz
===== CHANNEL f2 =====
CPDPRG2      MARIAGE
NUC2          1H
P2            90.00 usec
PL2           0.00 dB
RF2           400.1412618 MHz
SFO2          400.1412618 MHz
=====
F2 - Processing parameters
SI            32768
SF            75.4677612 MHz
WDW           EM
SSB           0
LB            3.20 Hz
GB            0
PC            1.46
=====
10 user 0.001 characters
CX            20.20 cm
CY            5.00 cm
CZ            219.155 mm
F1            15079.13 Hz
F2            -146.51 Hz
PRGPRG       11.98084 ppm/Ca
HDCP         899.28070 Hz/Ca
=====

```

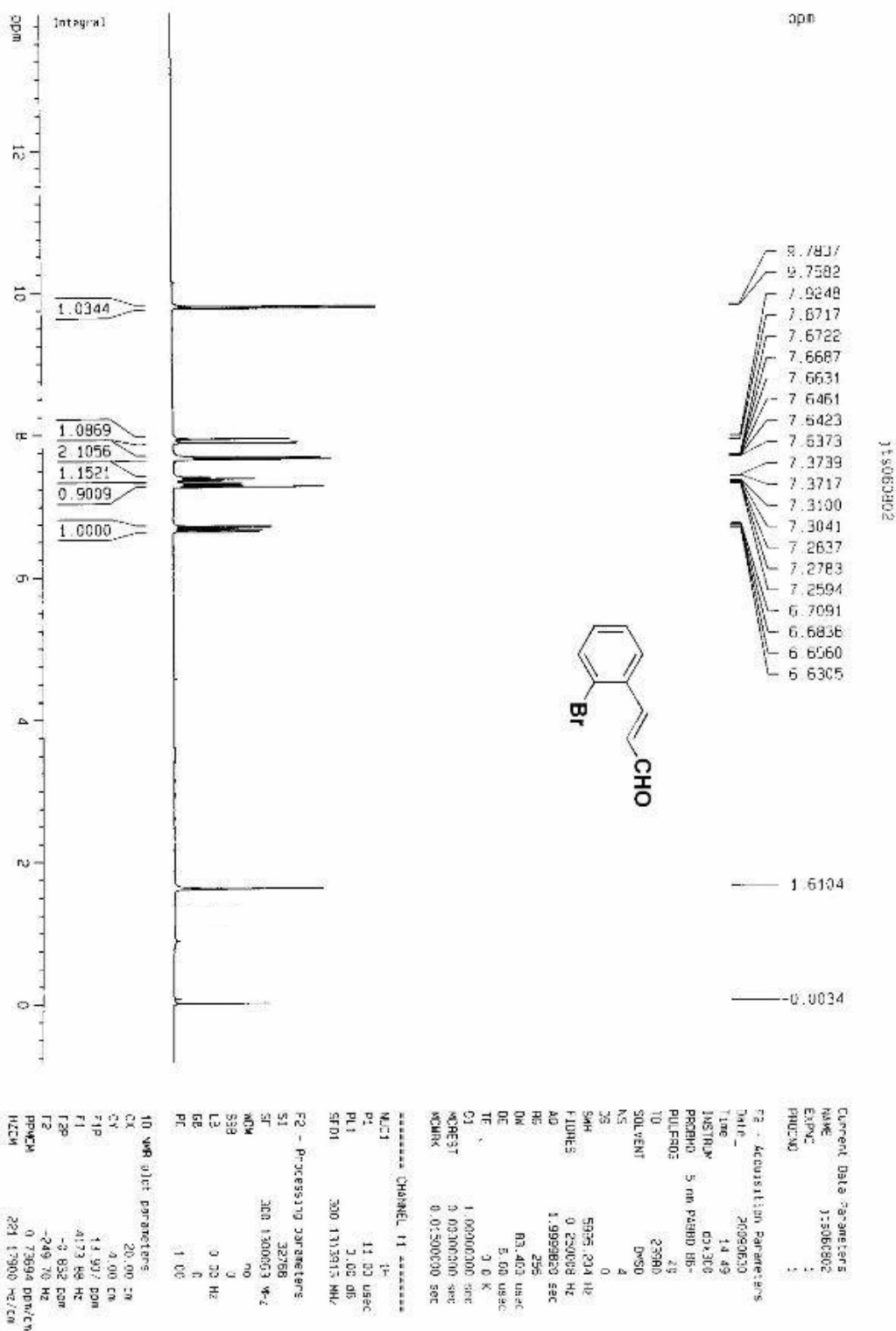

5-Chloro-2-methoxy-cinnamaldehyde (7)



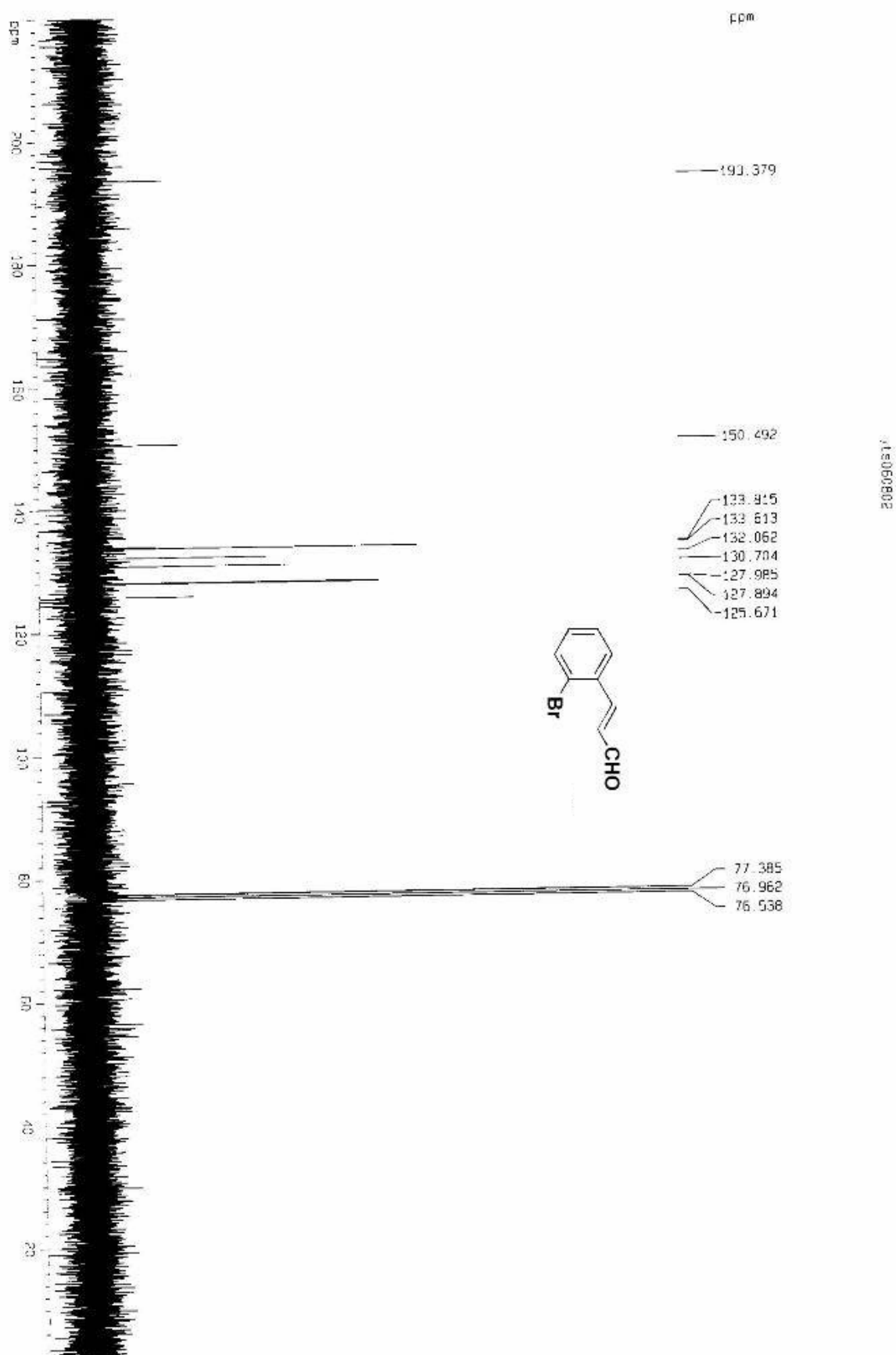
5-Chloro-2-methoxy-cinnamaldehyde (7)



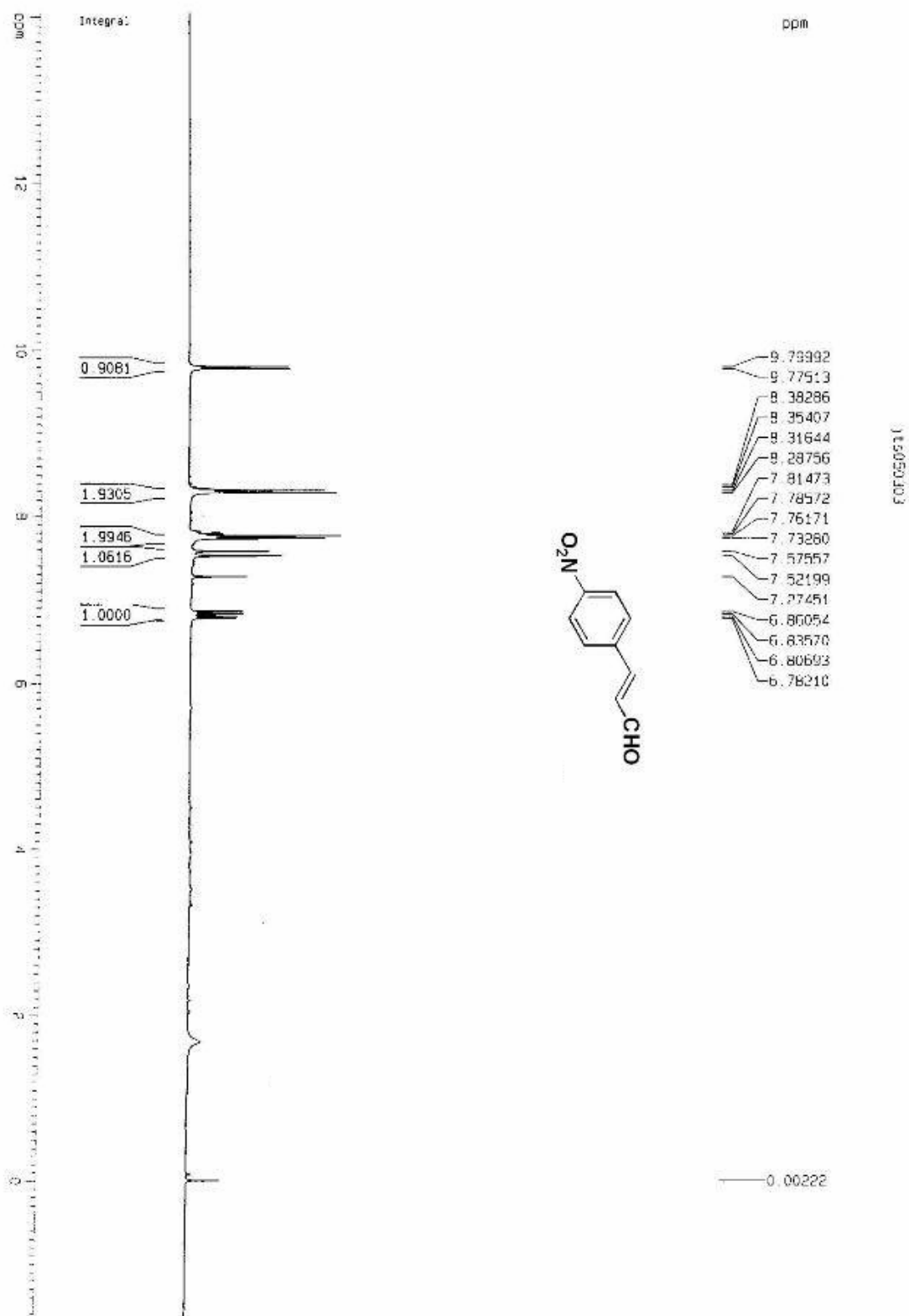
2-Bromo-cinnamaldehyde (8)



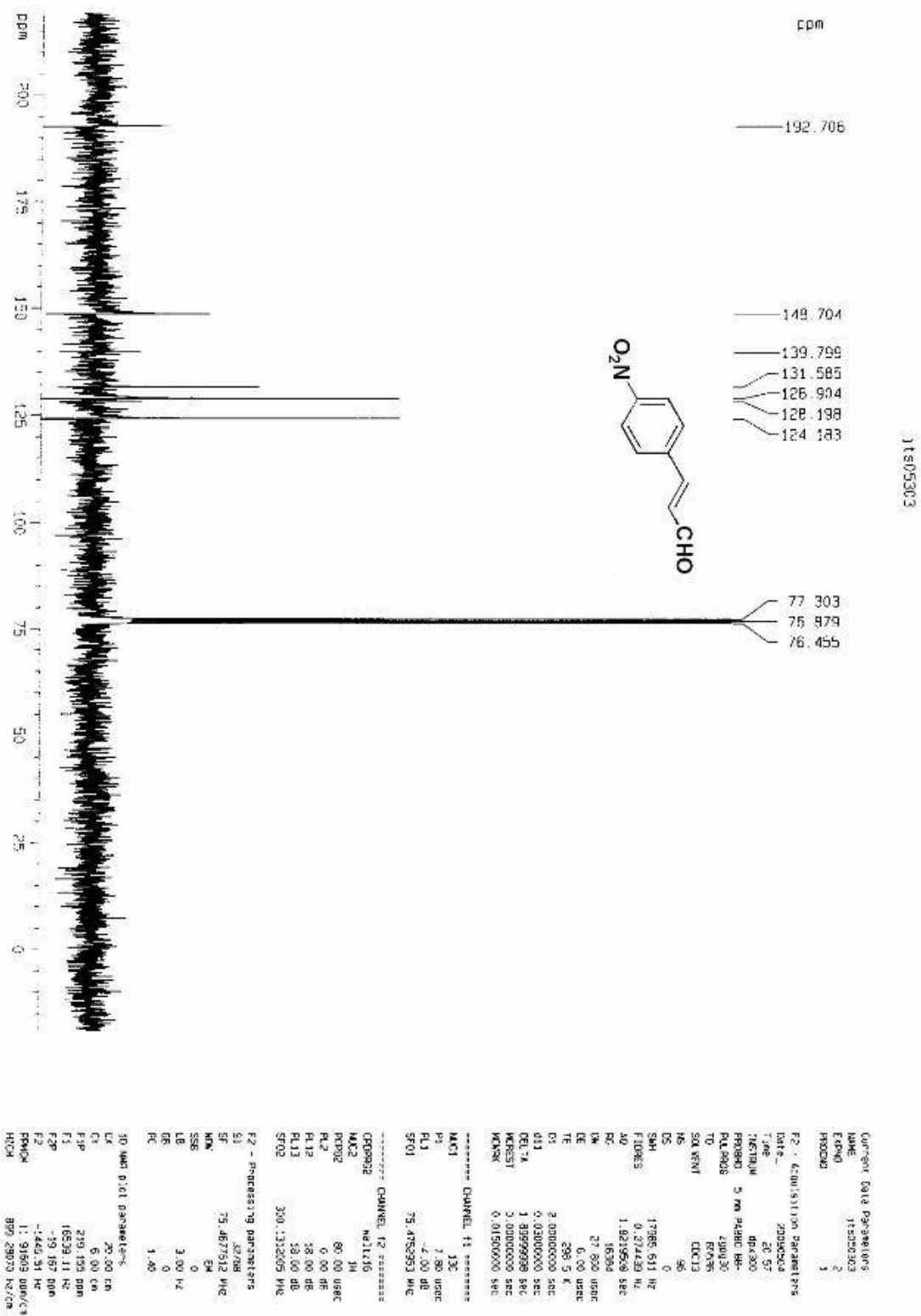
2-Bromo-cinnamaldehyde (8)



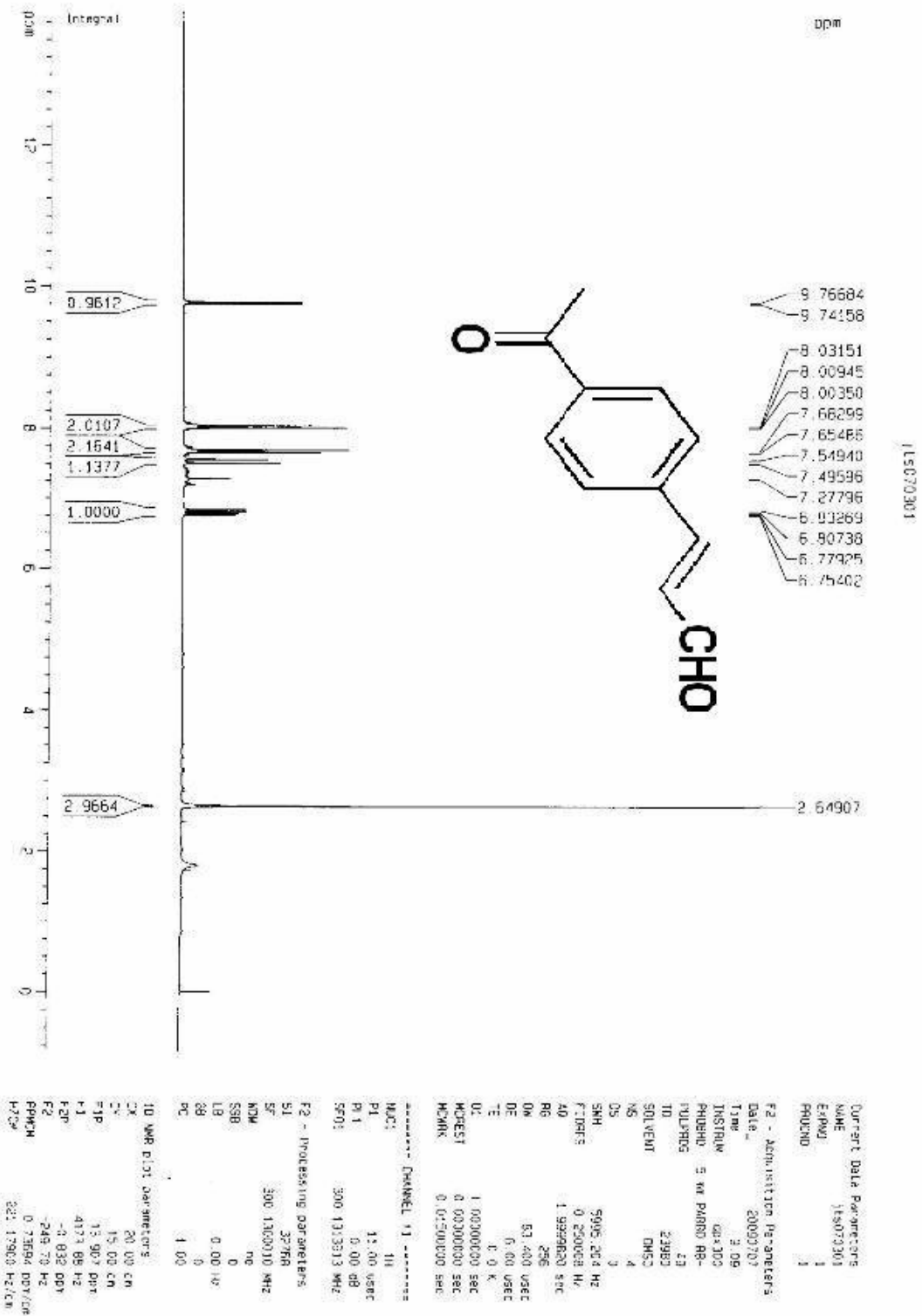
4-Nitro-cinnamaldehyde (9)



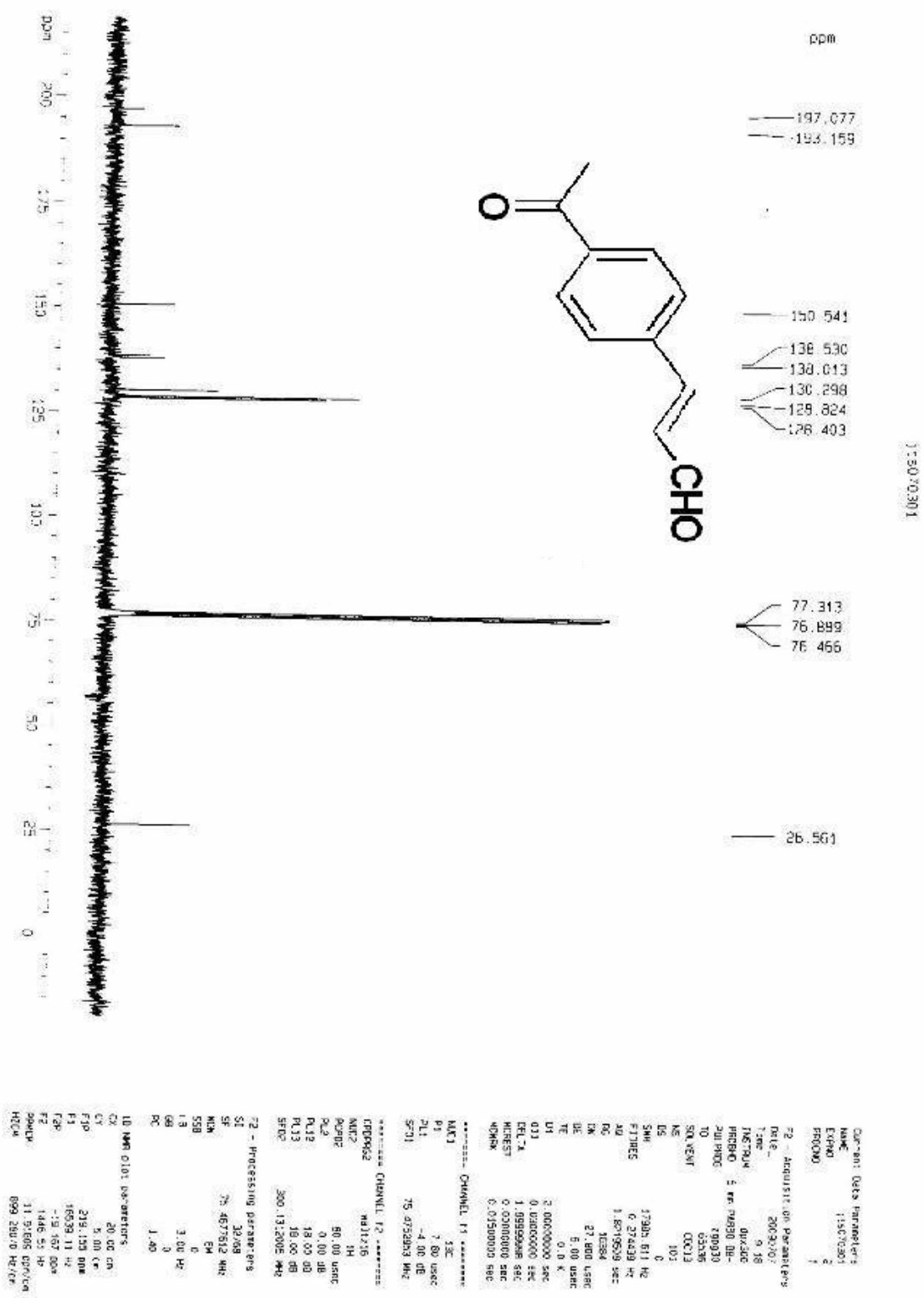
4-Nitro-cinnamaldehyde (9)



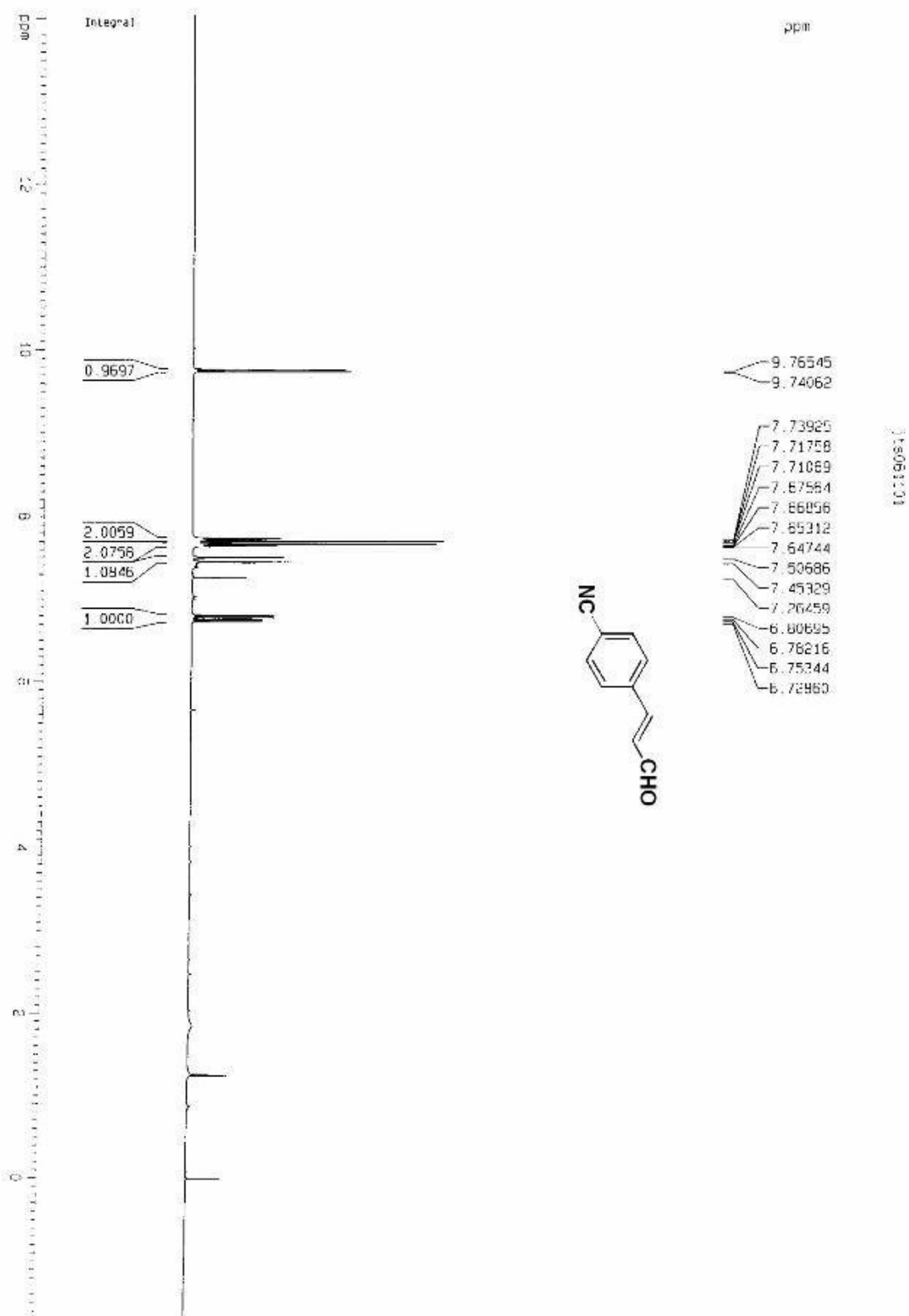
4-Acetyl-cinnamaldehyde (10)



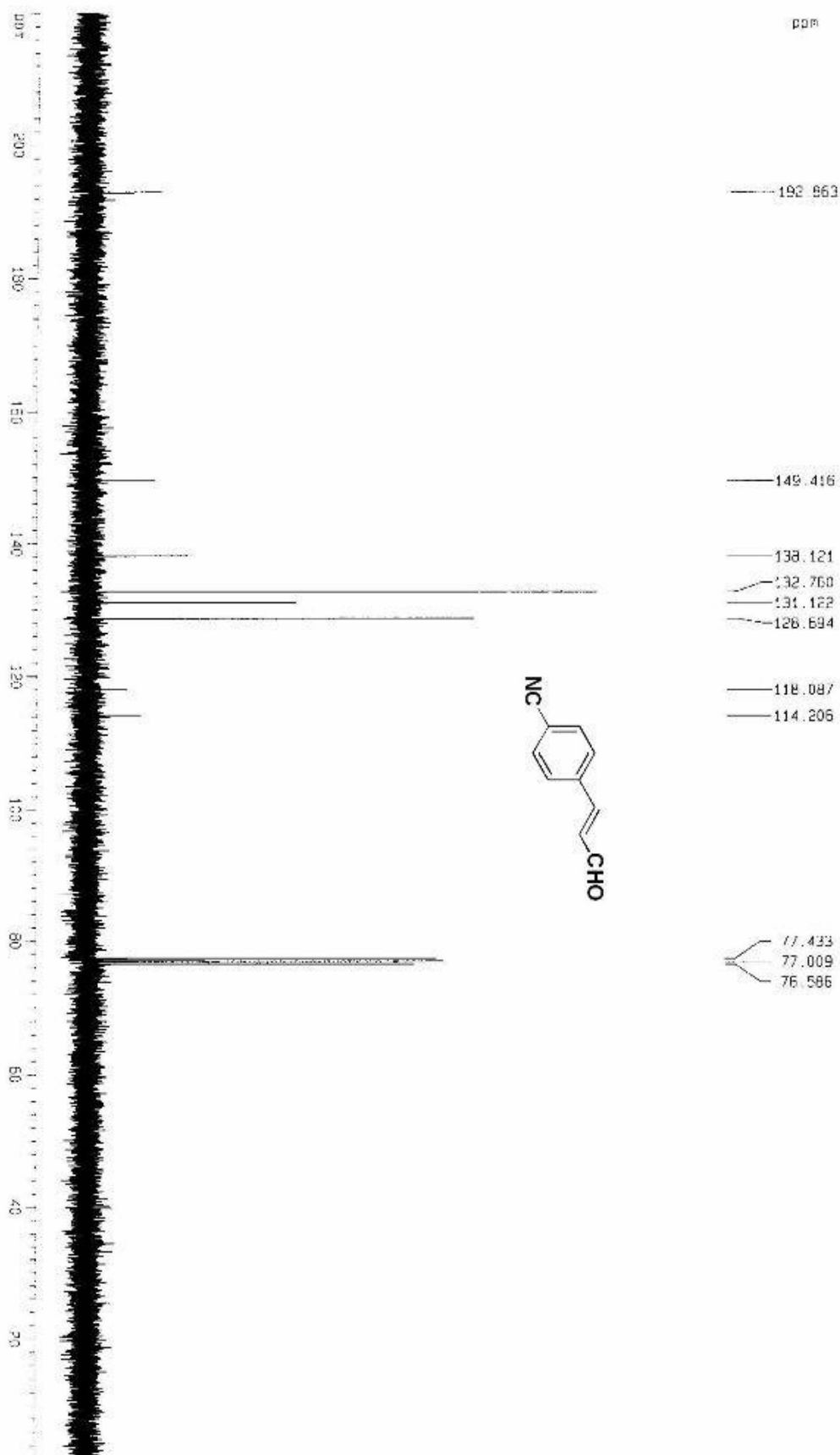
4-Acetyl-cinnamaldehyde (10)



4-Cyano-cinnamaldehyde (11)

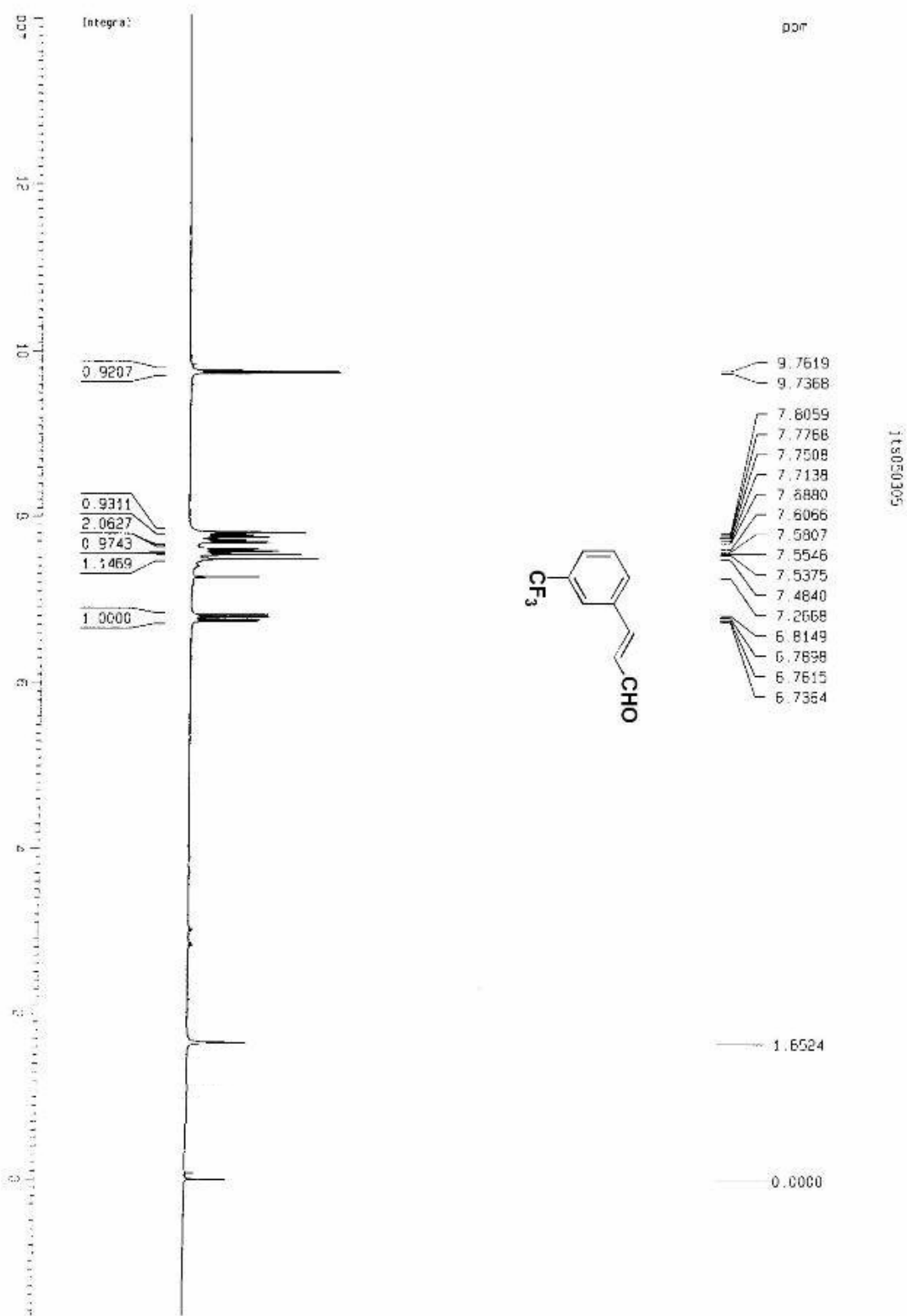


4-Cyano-cinnamaldehyde (11)

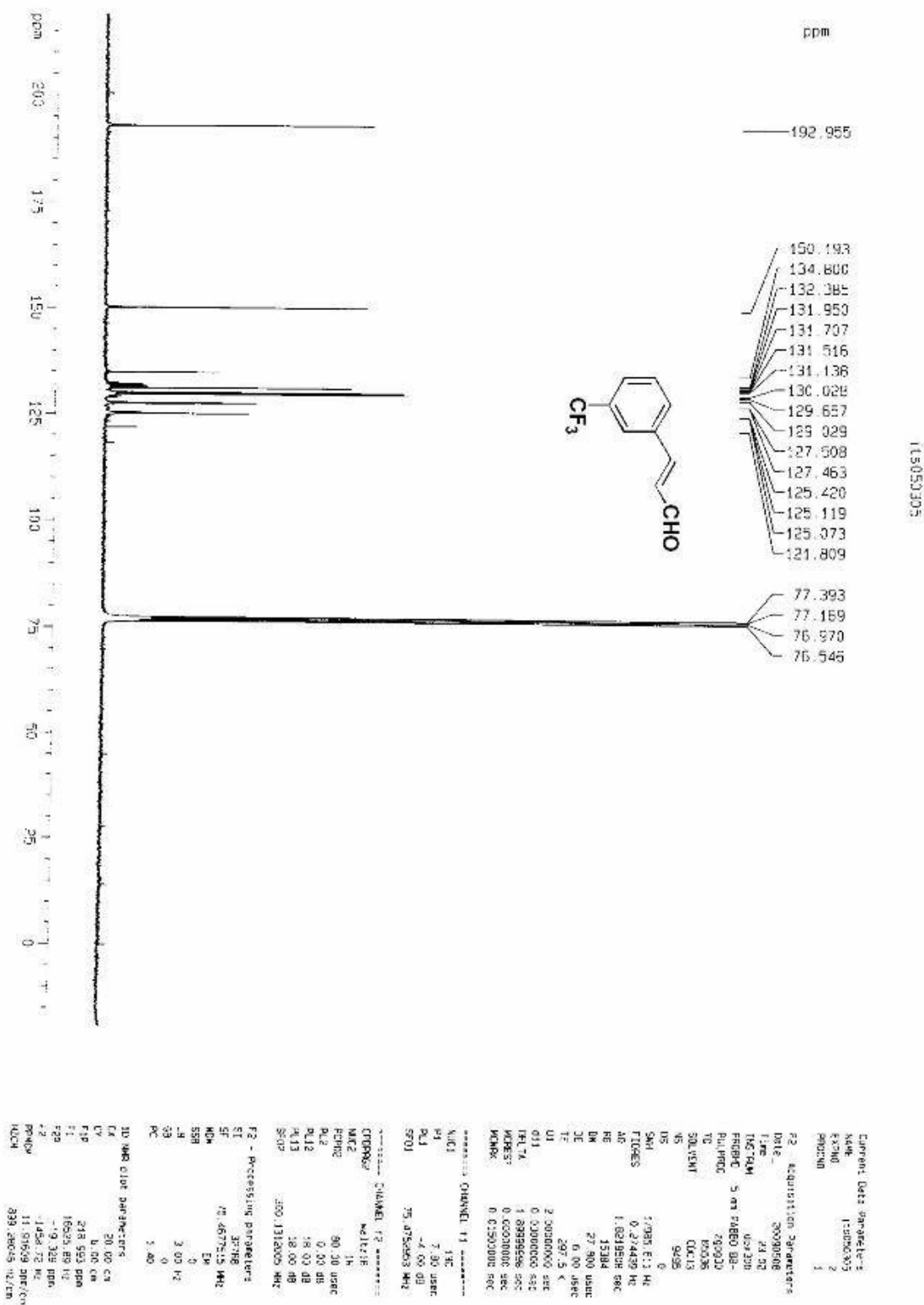


J15061101

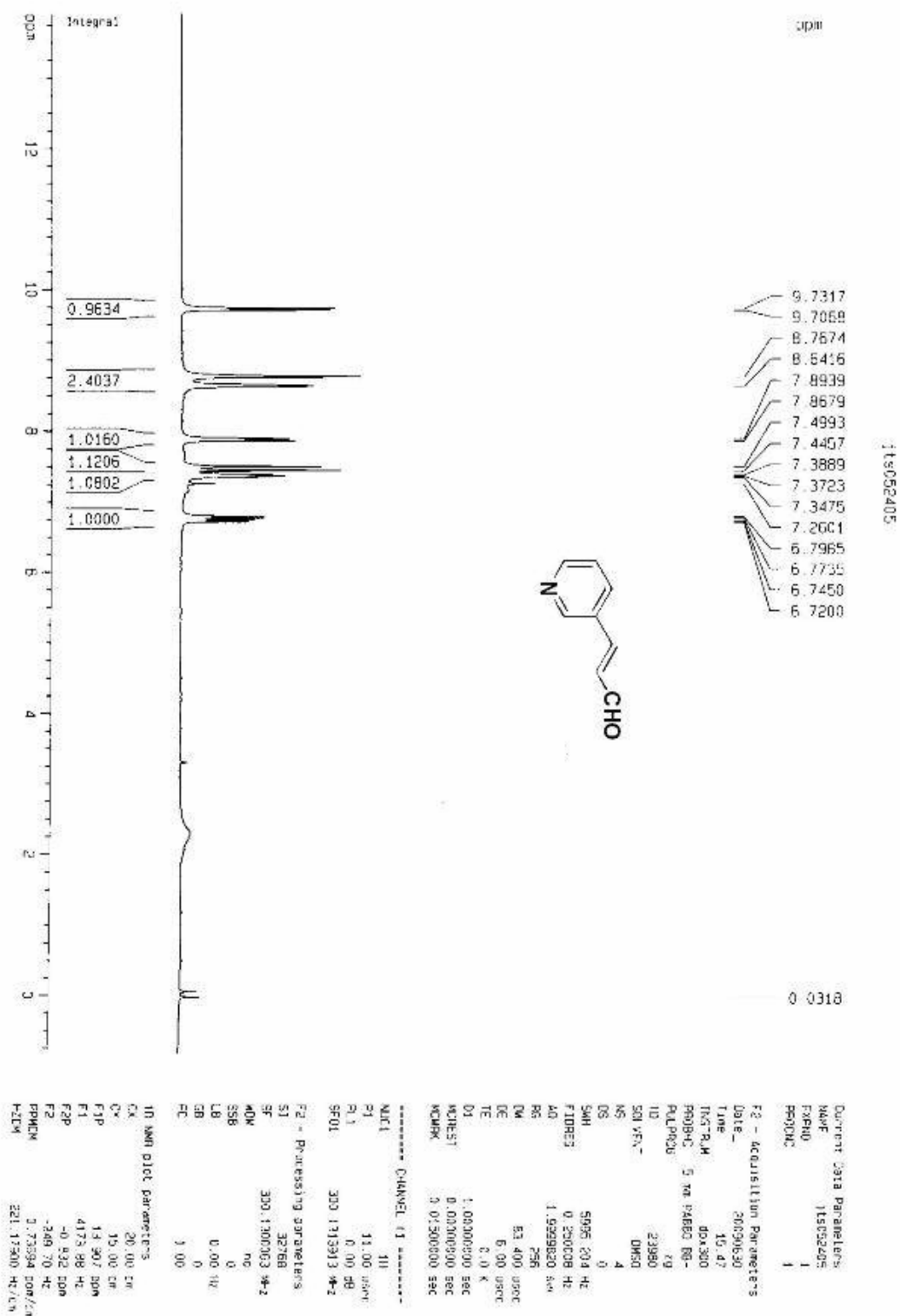
3-Trifluoromethy-cinnamaldehyde (12)



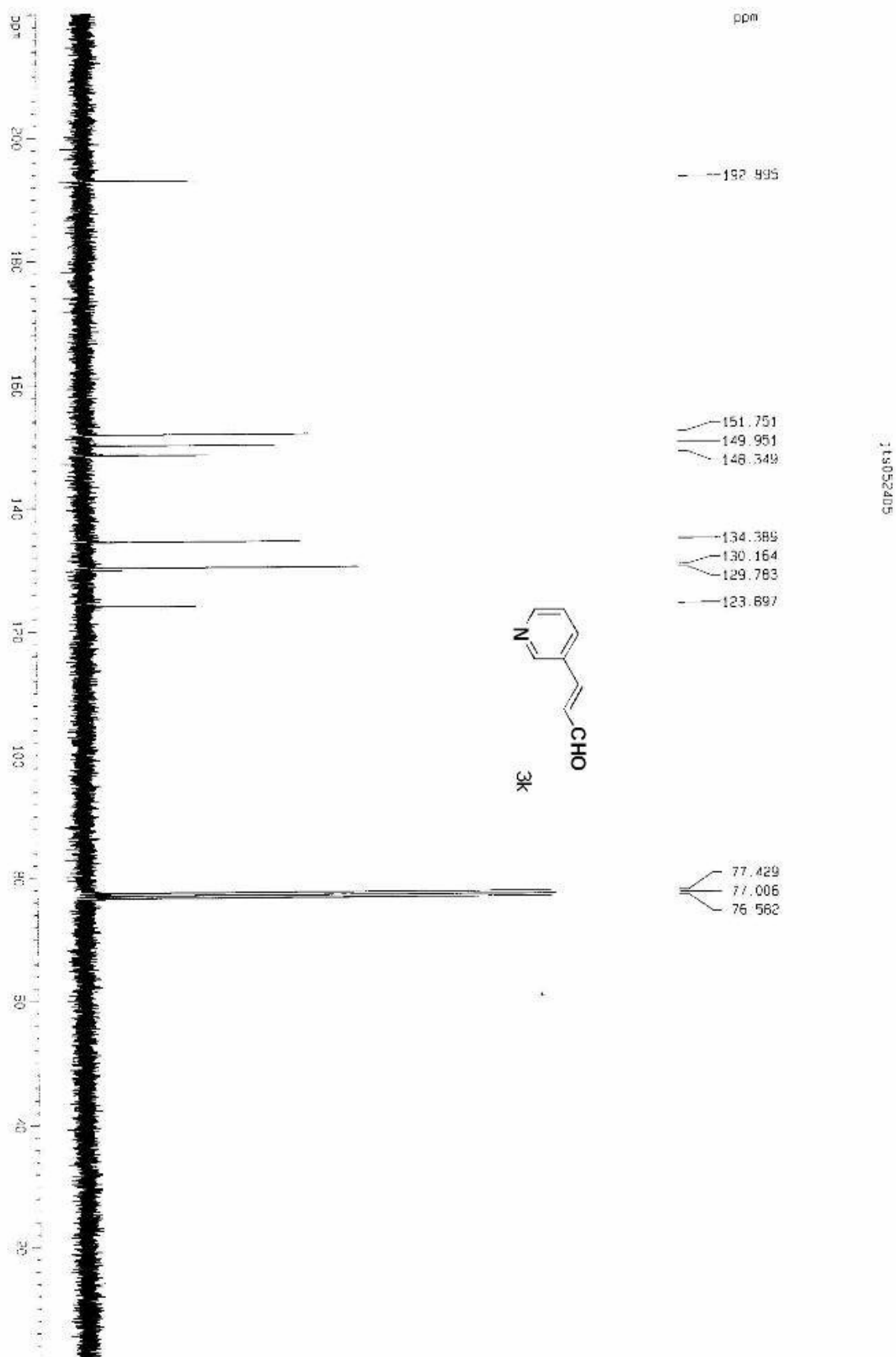
3-Trifluoromethyl-cinnamaldehyde (12)



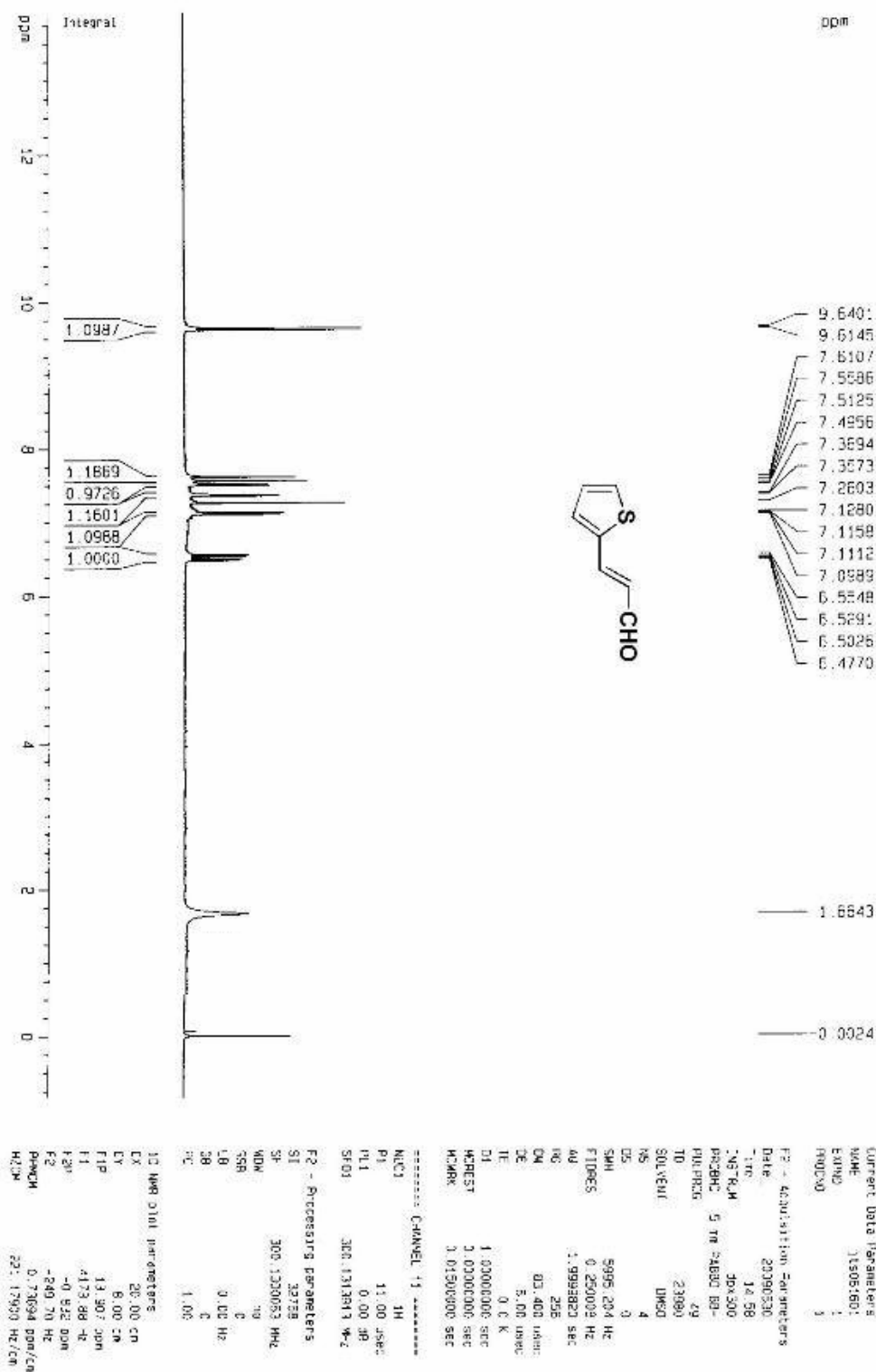
(E)-3-(Pyridin-3-yl)acrylaldehyde (13)



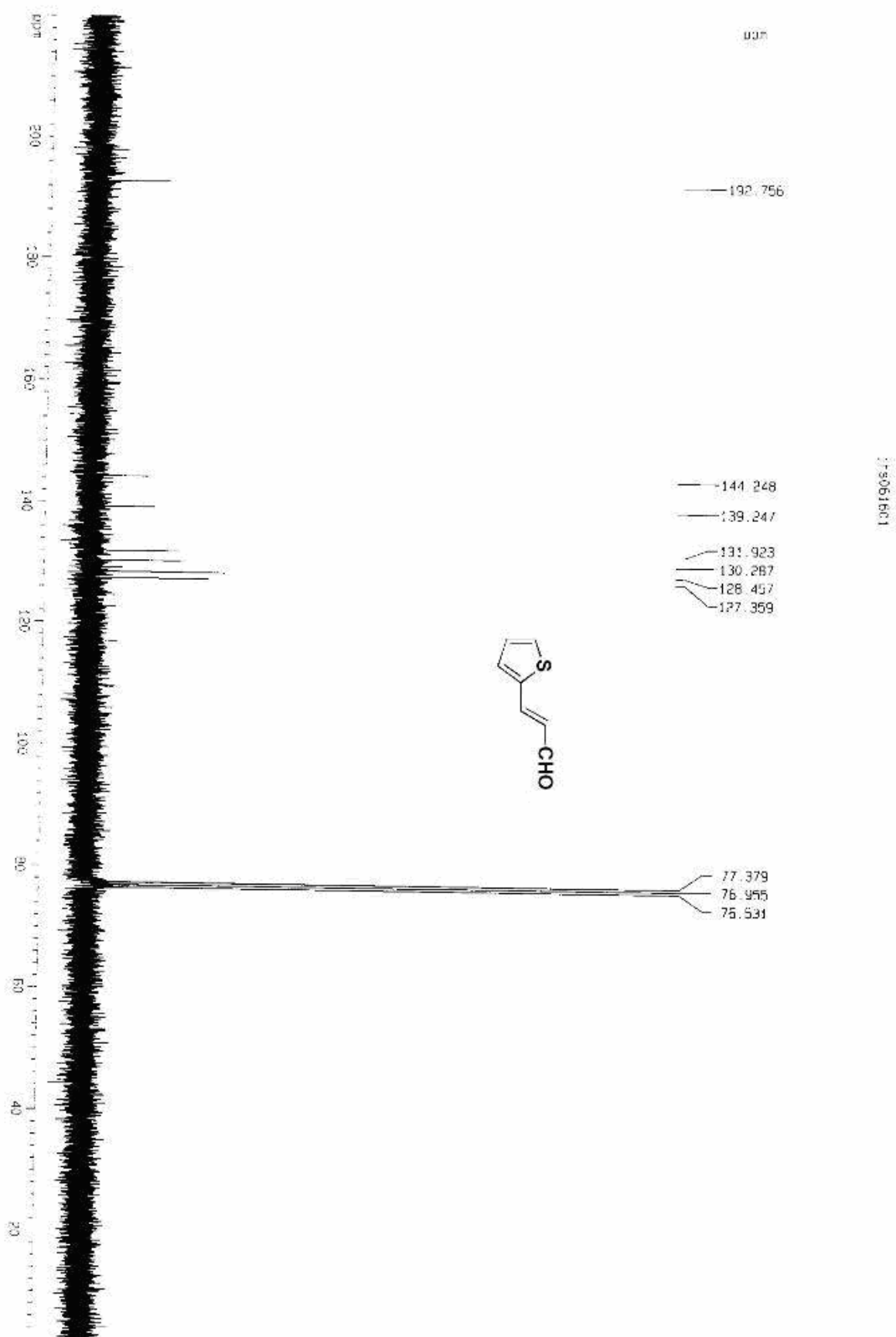
(E)-3-(Pyridin-3-yl)acrylaldehyde (13)



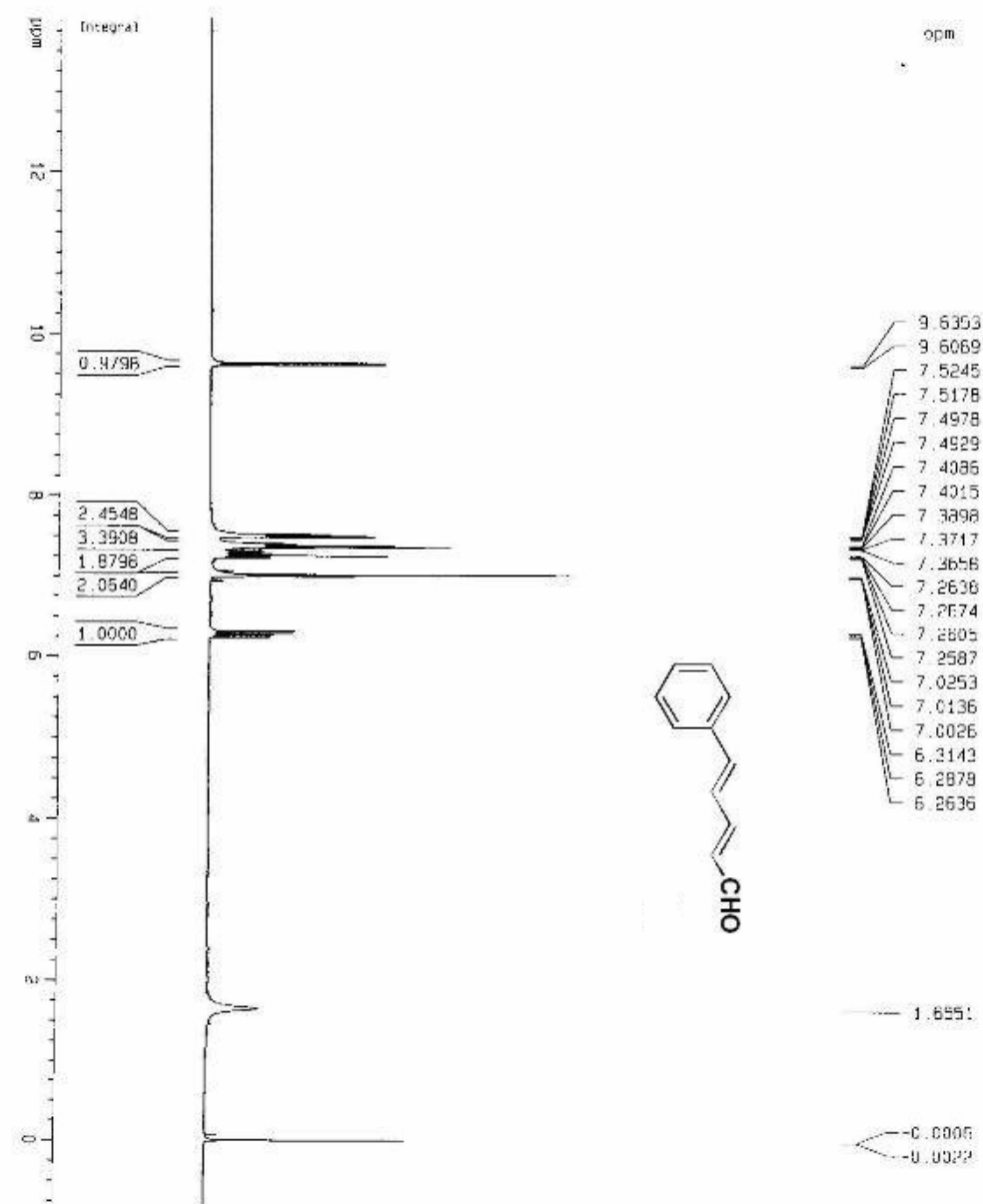
(E)-3-(Thiophen-2-yl)acrylaldehyde (14)



(E)-3-(Thiophen-2-yl)acrylaldehyde (14)



5-Phenylpenta-2,4-dienal (15)



Current Data Parameters
NAME 15052703
EXPNO 1
PROCNO 1

F2 - Acquisition Parameters
Date_ 20/06/00
Time 15.30
INSTRUM dpx300
PROBHD 5 mm PABBO BB-
PULPROG zg
TD 25984
SOLVENT CHCl3
NS 4
DS 3
SWH 5095.204 Hz
FIDRES 0.200012 Hz
AQ 1.9998620 sec
RG 356
CM 63.400 usec
DE 6.00 usec
TE 300.2 K
D1 1.00000000 sec
NOESY 1.00000000 sec
MORPH 0.01500000 sec

----- CHANNEL f1 -----
NUC1 1H
PC 11.00 usec
PL1 0.00 dB
SF01 300.1313012 MHz

F2 - Processing parameters:
SI 32768
SF 300.130053 MHz
KRM no
SSB 0
LB 0.00 Hz
GB 0
PC 1.00

1D NMR P1/D1 Parameters
CX 20.00 cm
CY 6.00 cm
F1+ 15.907 MHz
F1 4173.88 MHz
F2 -0.832 MHz
PNUC1 0.72684 DPM/CM
HZ1M 227.17200 MHz

5-Phenylpenta-2,4-dienal (15)

