Electronic Supporting Information (ESI)

Chemo-enzymatic syntheses of drimane-type sesquiterpenes and of a cyclic core of the meroterpene by recombinant squalene-hopene cyclase

Yukie Yonemura, Takuro Ohyama, and Tsutomu Hoshino*

Department of Applied Biological Chemistry, Faculty of Agriculture, and Graduate School of Science and Technology, Niigata University, Nishi-ku, Ikarashi 2-8050, Niigata 950-2181, Japan

*hoshitsu@agr.niigata-u.ac.jp

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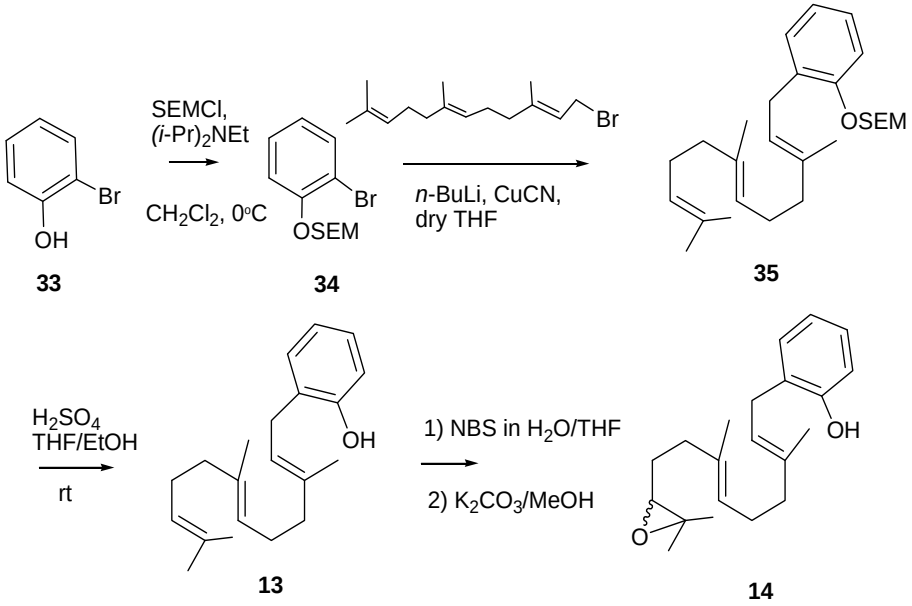
1. Syntheses of substrates 9, 13 and 14.

Preparation of substrate 9

Farnesol **4** was subjected to the mesylation reaction with MsCl/ Et_3N in dry CH_2Cl_2, followed by $LiAlH_4$ reduction in dry Et_2O, yielding the desired **9**. The synthetic method was essentially the same as our previous report (T. Hoshino, S. Nakano, T. Kondo, T. Sato and A. Miyoshi, *Org. Biomol. Chem.*, 2004, **2**, 1456-1470. ^{1}H NMR (400 MHz, $CDCl_3$) δ5.22 (q, *J*=7.0 Hz), 5.11 (2H, m), 2.15-2.04 (4H, m), 2.10-1.95 (4H, m), 1.68 (3H, s), 1.61 (9H, s), 1.57 (3H, d, *J*=7.0 Hz) ; ^{13}C NMR (100.6 MHz, $CDCl_6$) δ 135.7 (s), 134.9 (s), 131.2 (s), 124.4 (d), 124.3 (d), 118.2 (d), 39.71 (2xC, t), 26.73 (t), 26.61 (t), 25.68 (q), 17.66 (q), 15.95 (q), 15.64 (q), 13.33 (q). EIMS *m*/*z* (%): 69 (100), 81 (34), 95 (23), 136 (12), 137 (13), 163 (5), 191 (12), 206 (M^+, 2).

Preparation of substrates 13 and 14



All the reactions were conducted under nitrogen atmosphere.

*Synthesis of **34**.* 2-Bromophenol **33** (300 mg, 1.7 mmol) and (*i*-Pr)$_2$NEt (0.945 ml, 3.2 equiv.) were dissolved in 6 ml of CH_2Cl_2 and cooled on ice. To the solution, SEMCl (0.660 ml, 2.2 equiv.) was added in a drop-wise and stirred for 2 h. The reaction mixture was poured into ice-water and extracted with hexane (10 ml x 3), which was washed with sat. brine and dried over Na_2SO_4. The product was purified with a SiO_2 column chromatography (hexane: EtOAc=100:20) to yield 545 mg

(100 % yeold). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 (dd, *J*=7.8, 1.6 Hz), 7.18 (dd, *J*=7.8, 1.6 Hz), 7.03 (ddd, (dd, *J*=7.8, 7.8, 1.6 Hz), 6.62 (ddd, (dd, *J*=7.8, 7.8, 1.6 Hz), 5.06 (2H, s), 3.76 (2H, t, *J*=8.0 Hz), 0.946 (2H, t, *J*=8.0 Hz), 0.017 (9H, s).

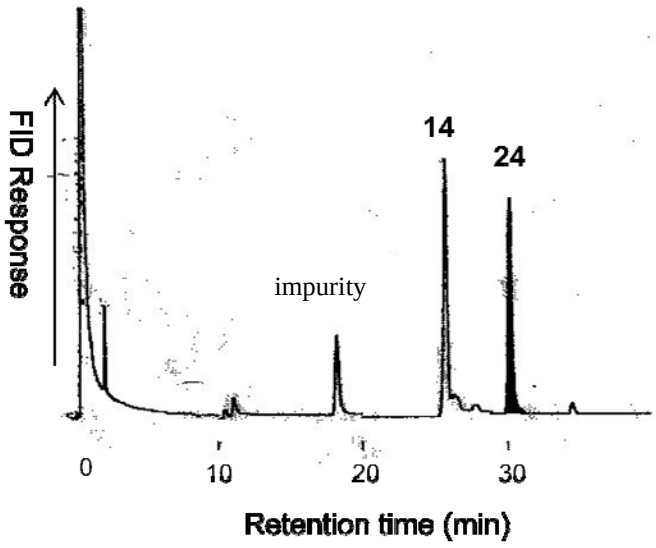
*Synthesis of **35***. A solution of **34** (475 mg, 1.5 mmol) dissolved in dry THF (7 ml) was cooled to -78°C. To the solution, *n*-BuLi (1.60M in *n*-hexane, 1.05 ml, 1 equiv.) was added in a small portion and then stirred for 30 min to afford a pale yellow suspension. CuCN (270 mg, 2 equiv.) was added to the suspension, which was warmed up to -10°C, yielding a red brown colored solution (whole portion of CuCN added was dissolved). The solution was cooled again to -78°C and the THF solution of farnesyl bromide 426 mg, 1.5 mmol), prepared with PBr_3, was added in a drop-wise manner into the reaction flask and stirred for 3 h. The reaction mixture was poured into ice-water and the products were extracted with hexane (100 ml x 3) and dried over Na_2SO_4. Two major products (557 mg as mixture) including **35** were visible on SiO_2 TLC were used in a next reaction without purification.

*Synthesis of **13***. The mixture (145 mg), prepared by the above reaction, was dissolved in 2 ml of a mixture of EtOH and THF (1:1). To the solution, was added 0.3 ml of a mixed solution ($EtOH/H_2SO_4$=30:1 v/v) and allowed to stand overnight. $NaHCO_3$ (5%) was added and the pH was adjusted to 7~8. The products were extracted with hexane (10 ml x 3) and washed with sat. brine, and then purified with SiO_2 column chromatography (100:0~0.2) to afford the desired **13** (37 mg, 35%). ^{1}H NMR (400 MHz, C_6D_6) δ 7.21 (d, *J*=7.8 Hz), 7.11 (t, *J*=7.8 Hz), 6.95 (*J*=7.8 Hz), 6.67 (d, *J*=7.8 Hz), 5.49 (1H, t, *J*=7.2 Hz), 5.34 (2H, m), 4.681 (1H, s, O*H*), 3.44 (d, *J*=7.2 Hz), 2.29-2.08 (8H, m), 1.79 (3H, s), 1.70 (3H, s), 1.69 (3H, s), 1.67 (3H, s); ^{13}C NMR (100.6 MHz, C_6D_6) δ 154.8 (s), 137.5 (s), 135.3 (s), 131.1 (s), 130.2 (d), 127.6 (d), 127.4 (s), 124.9 (d), 124.4 (d), 122.6 (d), 120.9 (d), 115.7 (d), 40.13 (t), 39.95 (t), 29.52 (t), 27.15 (t), 26.75 (t), 25.83 (q), 17.74 (q), 16.09 (q), 16.04 (q).

*Synthesis of **14***. The synthetic method was essentially the same as our previous report (T. Hoshino, S. Nakano, T. Kondo, T. Sato and A. Miyoshi, *Org. Biomol. Chem.*, 2004, **2**, 1456-1470. ^{1}H NMR (400 MHz, C_6D_6) δ 7.26 (dd, *J*=7.6, 1.6 Hz), 7.15 (ddd, *J*=7.6, 7.6, 1.6 Hz), 6.96 ((ddd, *J*=7.6, 7.6, 1.6 Hz), 6.94 (dd, *J*=7.6, 1.6 Hz), 5.59 (t, *J*=7.2 Hz), 5.29 (t, *J*=7.2 Hz), 3.57 (d, *J*=7.2 Hz), 2.72 (t, *J*=6.2 Hz), 2.22-2.07 (6H, m), 1.75 (3H, s), 1.67 (2H, m), 1.59 (3H, s), 1.24 (3H, s), 1.19 (3H, s); ^{13}C

NMR (C_6D_6, 100.6 MHz) δ15.96 (q), 16.01 (q), 18.76 (q), 26.32 (t), 29.25 (t), 29.84 (t), 36.67 (t), 39.76 (t), 58.32 (s), 63.99 (d), 115.7 (d), 120.6 (d), 123.5 (d), 124.6 (d), 127.5 (d), 130.3 (d), 134.2 (s), 136.2 (s), 155.1 (s).

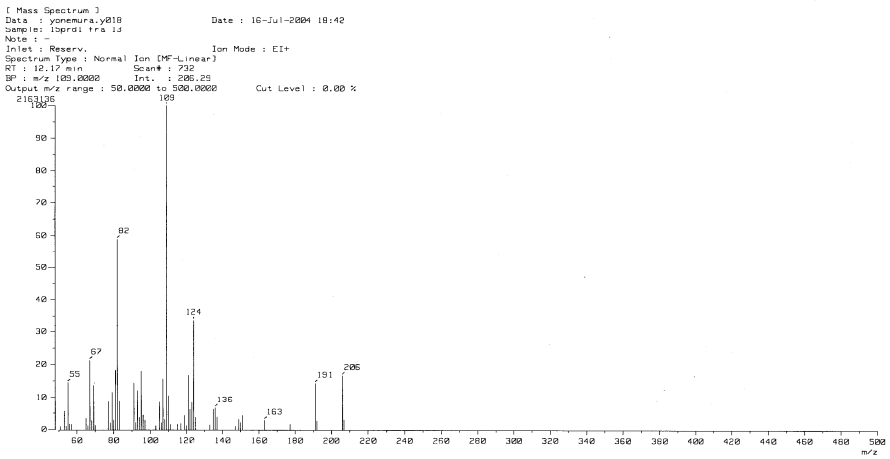
2. GC trace of the reaction mixture of 14 with SHC (an excess of Triton X-100 was removed).



Triton X-100 was removed by a short SiO2 column. GC conditions: column temp., 190°C; injection temp., 280°C; carrier gas (N_2), 0.5 kg/cm^2. Only one product **24** was produced.

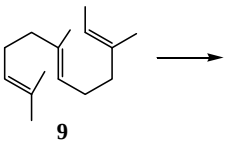
3. Spectroscopic data of product 15

(1) EIMS spectrum of product **15**



(2) NMR data analyses and other data for **15**

Product **15** (drim-7(8)-ene)



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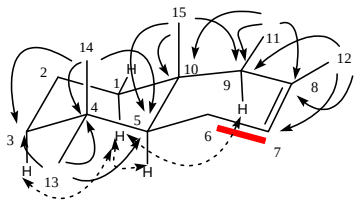
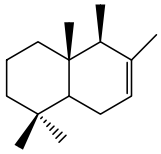


NOE
HMBC
COSY

400 MHz, C_6D_6



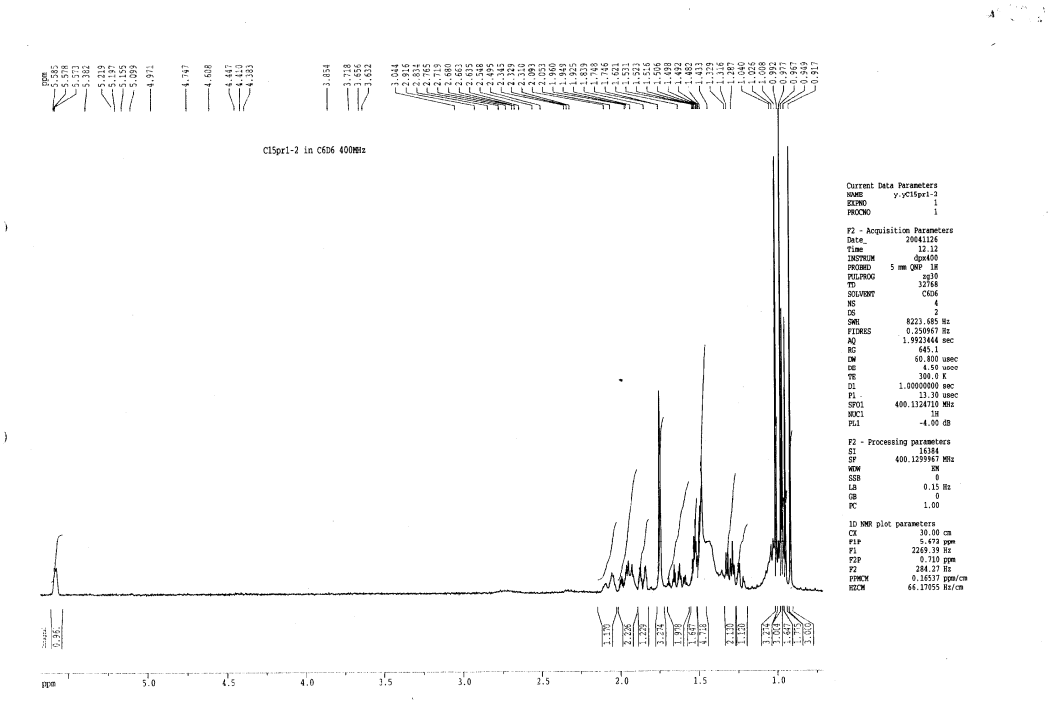
HRMS M^+
Observed:206.2067
Calculated:206.2035

$[a]_D^{25}$ -12.5
(*c*=0.012, C_6D_6)

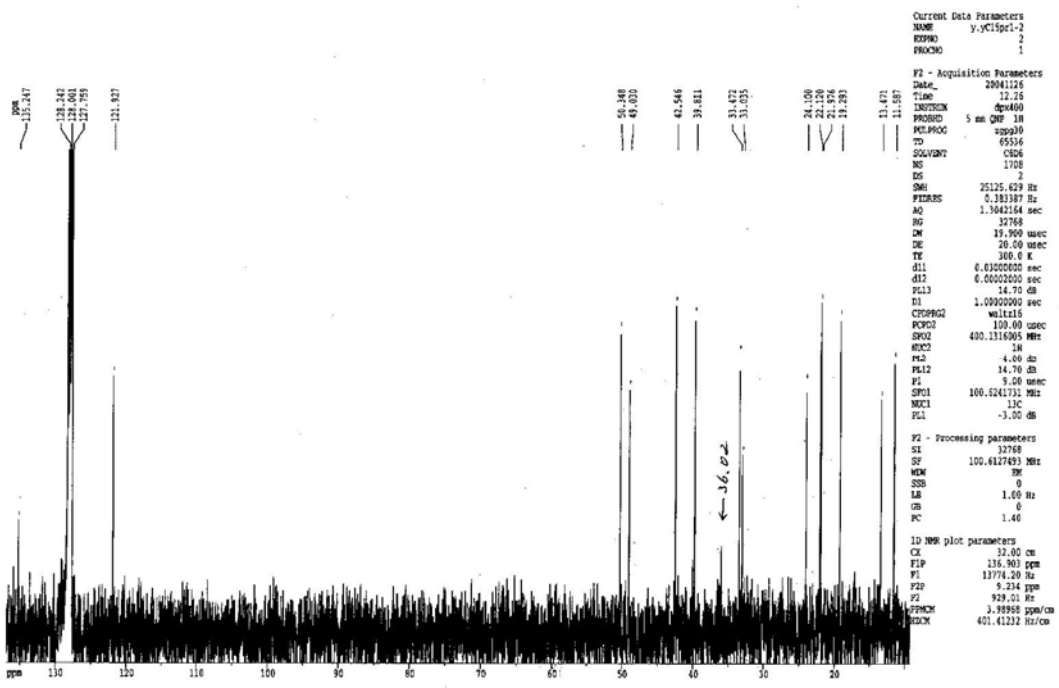
No	^{1}H	^{13}C	No	^{1}H	^{13}C
1	0.98(m); 1.86(m)	39.81	**9**	1.94 (m)	49.03
2	1.63 (m); 1.50 (m)	19.29	**10**	——	36.02
3	1.25 (ddd, 13.0, 12.8, 3.6Hz) ; 1.54 (m)	42.55	**11**	0.958(d, 7.2 Hz)	11.58
4	——	33.03	**12**	1.75 (3H, br s)	21.98 *a*
5	1.29 (dd, *J*=11.8, 5.2 Hz)	50.35	**13**	0.977(3H, s)	33.47
6	1.95 (m); 2.05(m)	24.10	**14**	1.008 (3H, s)	22.12 *a*
7	5.58 (brs)	121.93	**15**	0.917 (3H, s)	13.47
8	——	135.25			

a) The carbon signals of C-12 and C-14 are exchangeable due to the close values.

(3) ^{1}H-NMR spectrum of product **15** in C_6D_6.

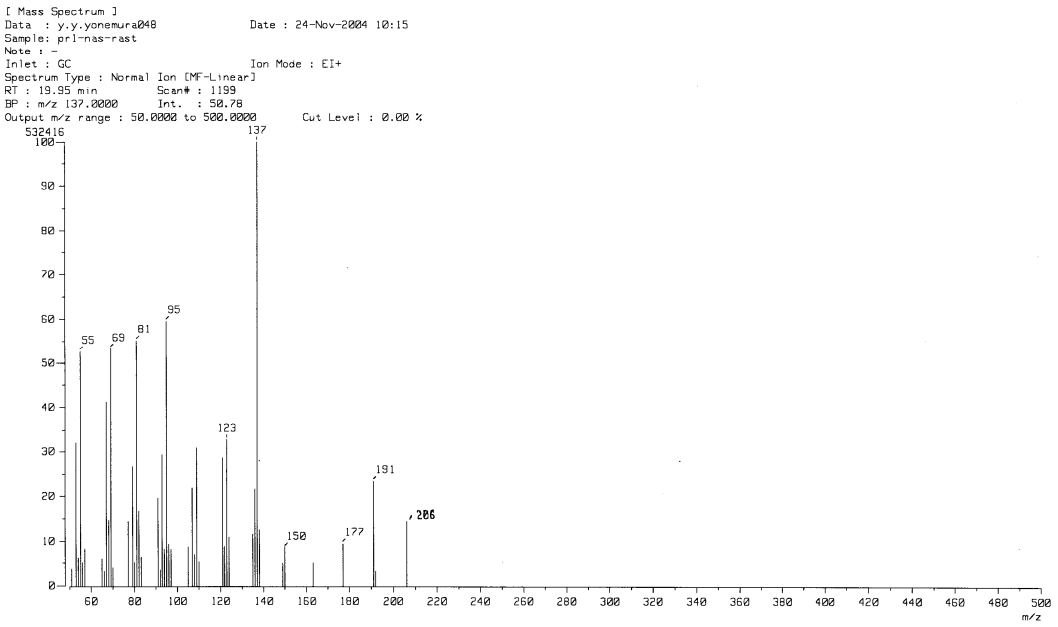


(4) ^{13}C-NMR spectrum of product **15** in C_6D_6.



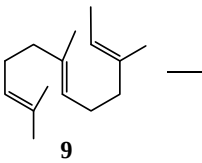
4. Spectroscopic data of product 16

(1) EIMS spectrum of product **16**



(2) NMR data analyses and other data for **16**

Product **16** (drim-8(12)-ene)



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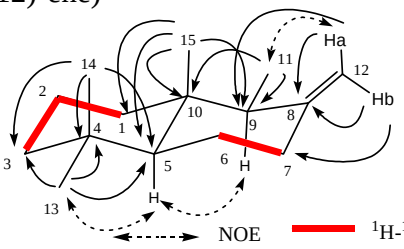
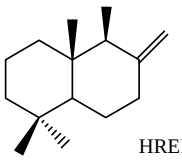




HREIMS M^+
Obserd: 206.2041
Calc.: 206.2035

$[\alpha]_D^{25}$= -20.7 (C_6H_6, c=0.01)

NOE ^{1}H-^{1}H COSY

HMBC

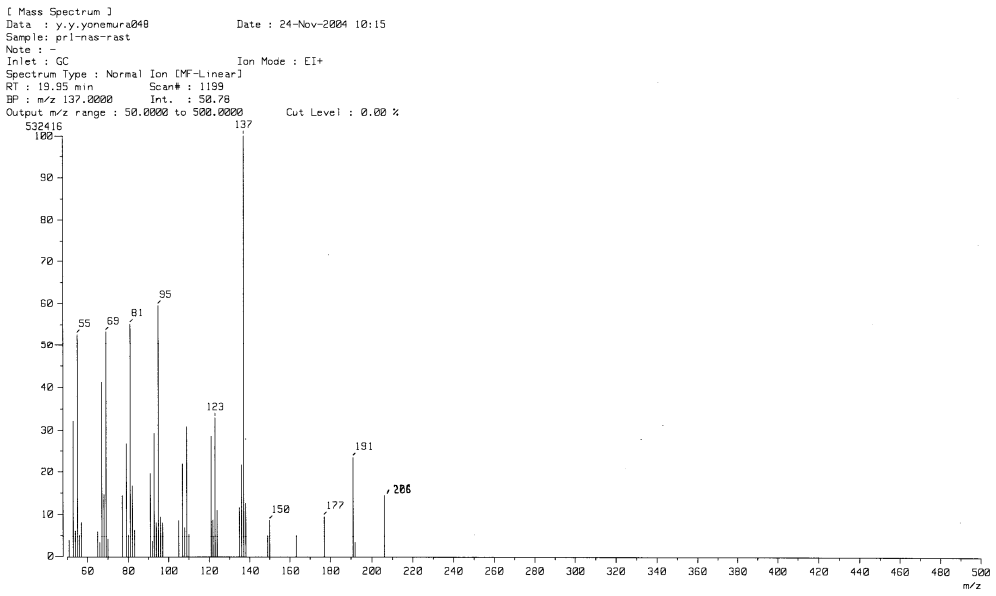
400 MHz, C_6D_6

The solvent peaks: 7.28 ppm for ^{1}H-NMR; 128.0 ppm for ^{13}C-NMR

No	^{1}H	^{13}C	No	^{1}H	^{13}C
1	0.98(m); 1.65 (m)	**39.54**	**9**	1.85 (bq, *J*=6.8 Hz)	**50.49**
2	1.46 (m); 1.54 (m)	**19.64**	**10**	——	**39.02**
3	1.22(m); 1.47(m)	**42.44**	**11**	1.04 (3H, d, J=6.8 Hz)	**10.64**
4	——	**33.51**	**12**	4.79 (s, Ha); 4.98 (s, Hb)	**151.5 (t)**
5	1.11 (m)	**55.41**	**13**	0.964 (3H, s)	**33.71**
6	1.43 (m);1.72 (m)	**24.17**	**14**	0.927 (3H, s)	**21.97**
7	2.51(ddd, J=12.8,4.4, 2.0 Hz);2.15 (ddd, J=12.8, 12.8, 4.4 Hz)	**37.72**	**15**	0.833 (3H, s)	**13.48**
8	——	**151.5**			

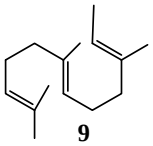
5. Spectroscopic data of product 17

(1) EIMS spectrum of product **17**



(2) NMR data analyses and other data for **17**

Product **17**



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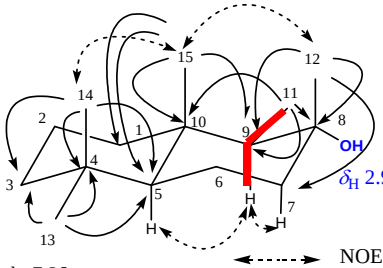
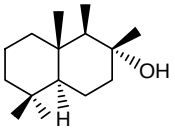


δ_H 2.90 (brs)

NOE
HMBC
COSY



17:driman-8α-ol

HREIMS M^+
Obserd: 206.2038 ($-H_2O$)
Calc.: 206.2035

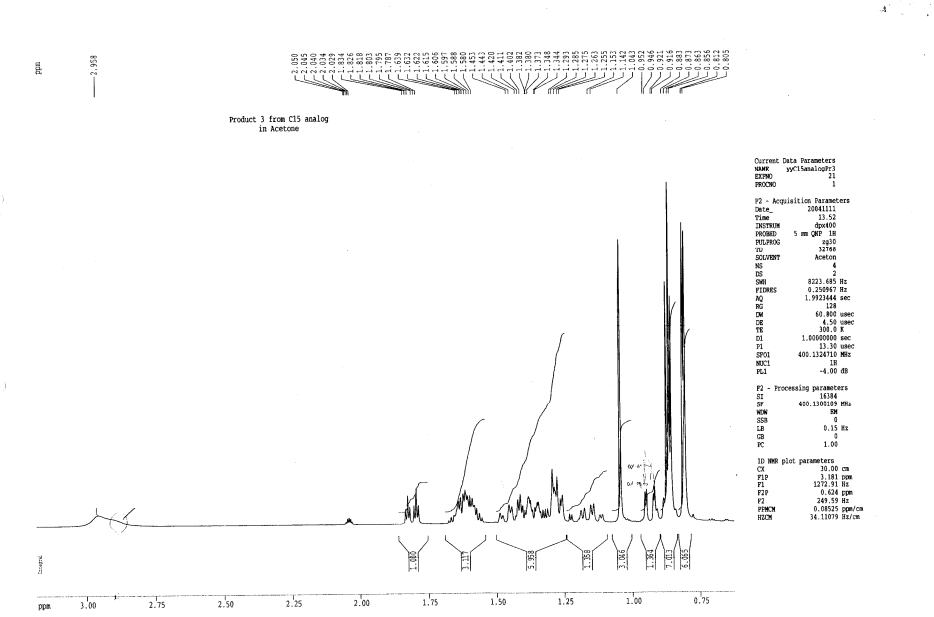
$[\alpha]_D^{25}$= -6.79 (EtOH c=0.01)
R_f vakue 0.37 (Hexane/EtOAC=100:20)

600 MHz in C_6D_6 (the solvent peak: 7.28 ppm for ^{1}H- and 128.0 ppm for ^{13}C NMR)

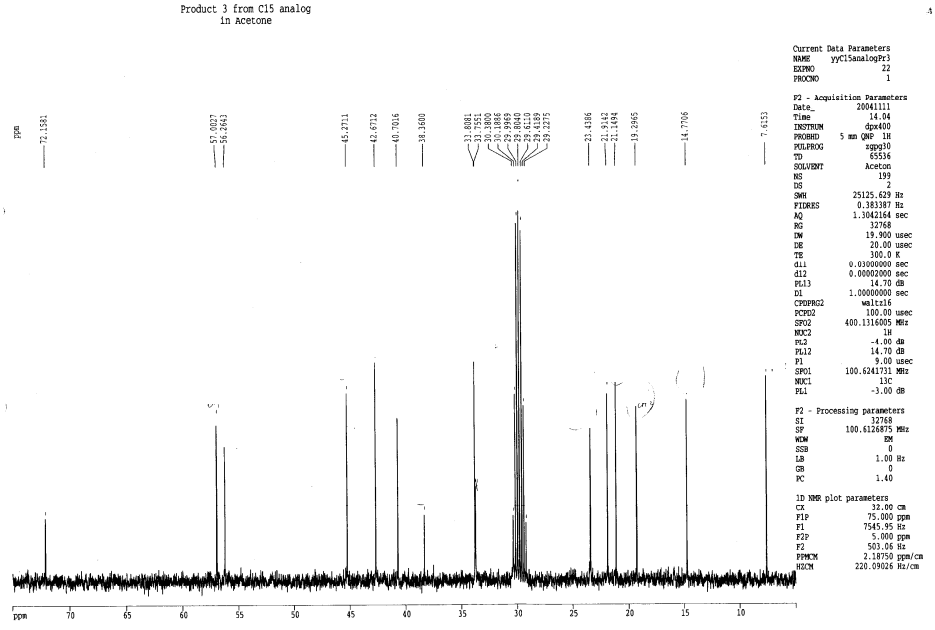
No	^{1}H	^{13}C	No	^{1}H	^{13}C
1	0.85 (m); 1.63 (m)	39.99	**9**	1.22 (m)	55.74
2	1.45 (m); 1.60 (m)	18.97	**10**	——	37.86
3	1.19 (m); 1.45 (m)	42.17	**11**	1.015 (3H, d, *J*=7.0 Hz)	7.46
4	——	33.26	**12**	1.13(3H, s)	23.21
5	0.87 (m)	56.14	**13**	0.959 (3H, s)	33.56
6	1.18 (m); 1.57 (m)	20.73	**14**	0.887 (3H, s)	21.73
7	1.39(ddd, 3.9, 12.7, 12.7); 1.89(ddd, 3.2,3.2, 12.7)	44.88	**15**	0.800 (3H, s)	14.45
8	——	72.25	OH	2.90 (br s) *a*	

a This OH signal was observed in acetone d_6, the chemical shift is expressed in relative to the solvent peak (2.04 ppm for ^{1}H NMR)

(3) ^{1}H-NMR spectrum of product **17** in acetone-d_6

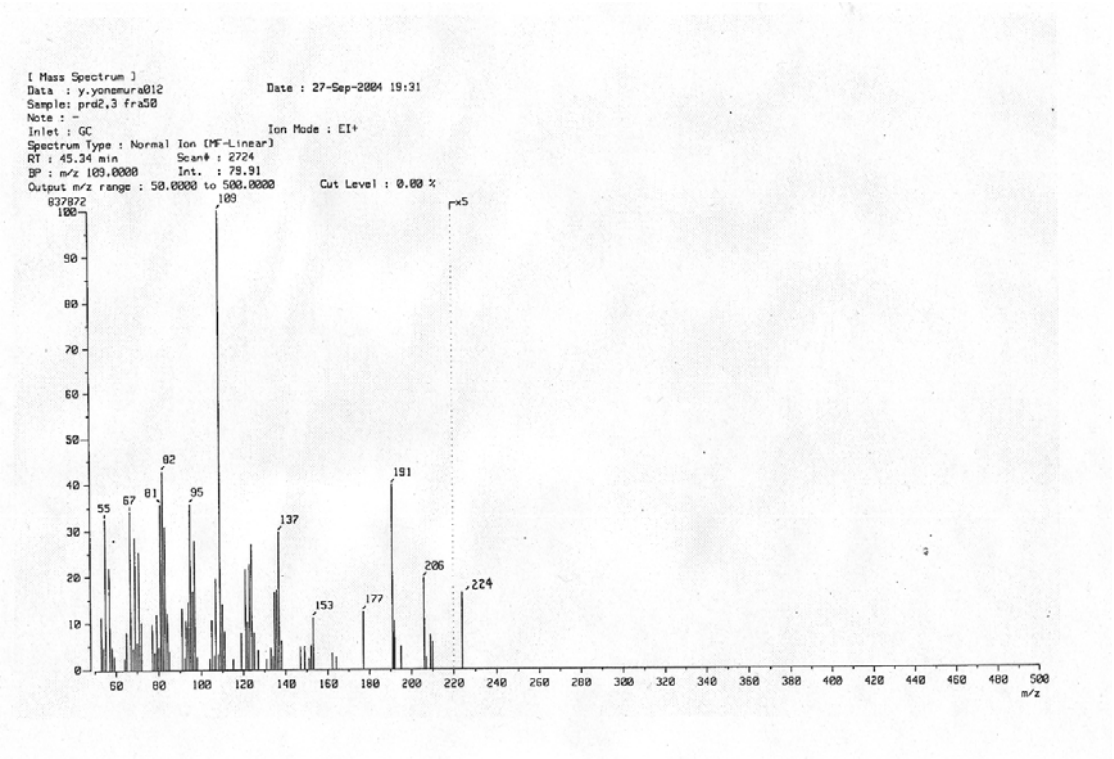


(4) ^{13}C-NMR spectrum of product **17** in acetone-d_6



6. Spectroscopic data of product 18

(1) EIMS spectrum of product **18**

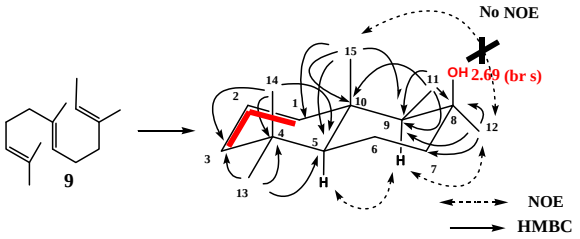


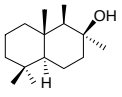
(2) NMR data analyses and other data for **18**

Product **18**

$[\alpha]_D^{25}$= -32.1(C_6H_6)
c=0.037
HRMS M^+
Observed:206.2022 (-H_2O)
Calculated:206.2035

R_f value 0.54 (hexane/EtOAc=100:20)





18:driman-8β-ol

COSY & HOHAHA

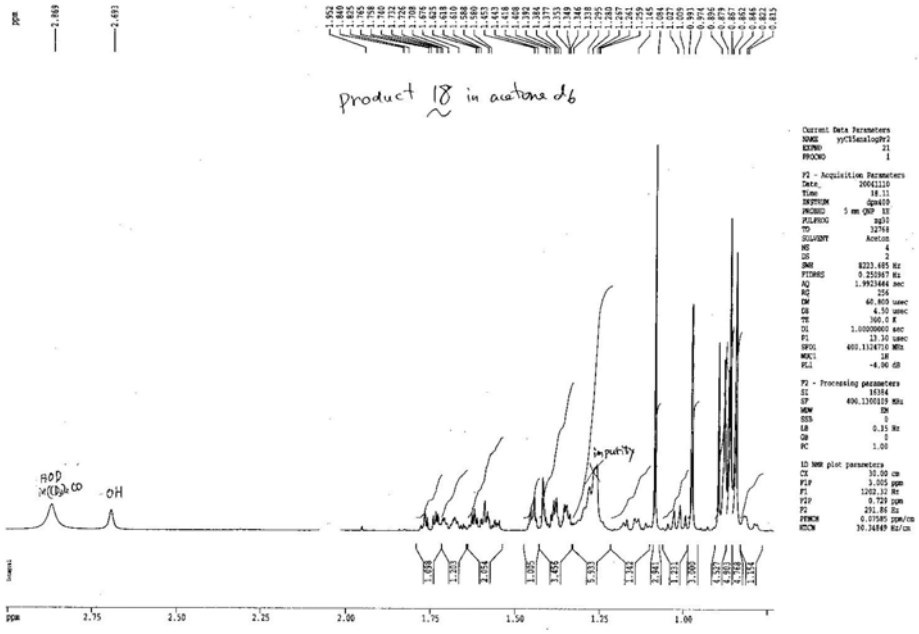
Chemical shifts in aceton d_6, the solvent peak:^{1}H,2.04ppm, ^{13}C,29.80ppm

No	^{1}H	^{13}C	No	^{1}H	^{13}C
1	0.82 (m); 1.68 (m)	40.82	**9**	1.01(1H, q, *J*=7.2 Hz)	53.58
2	1.35 (m); 1.59 (m)	19.31 [a]	**10**	——	38.65
3	1.14 (ddd, *J*=13.6, 13.6,4.4); 1.36 (m)	42.77	**11**	0.888 (3H, d, *J*=6.8 Hz)	7.88
4	——	33.88	**12**	1.08(3H, s)	31.41
5	0.87 (m)	56.89 [a]	**13**	0.862 (3H, s)	34.00
6	1.42 (m); 1.59 (m)	19.25	**14**	0.846 (3H, s)	22.19
7	1.43(m);1.76(m)	43.62	**15**	0.974(3H, s)	14.88
8	——	71.84	**OH**	2.69 (br s) [b]	

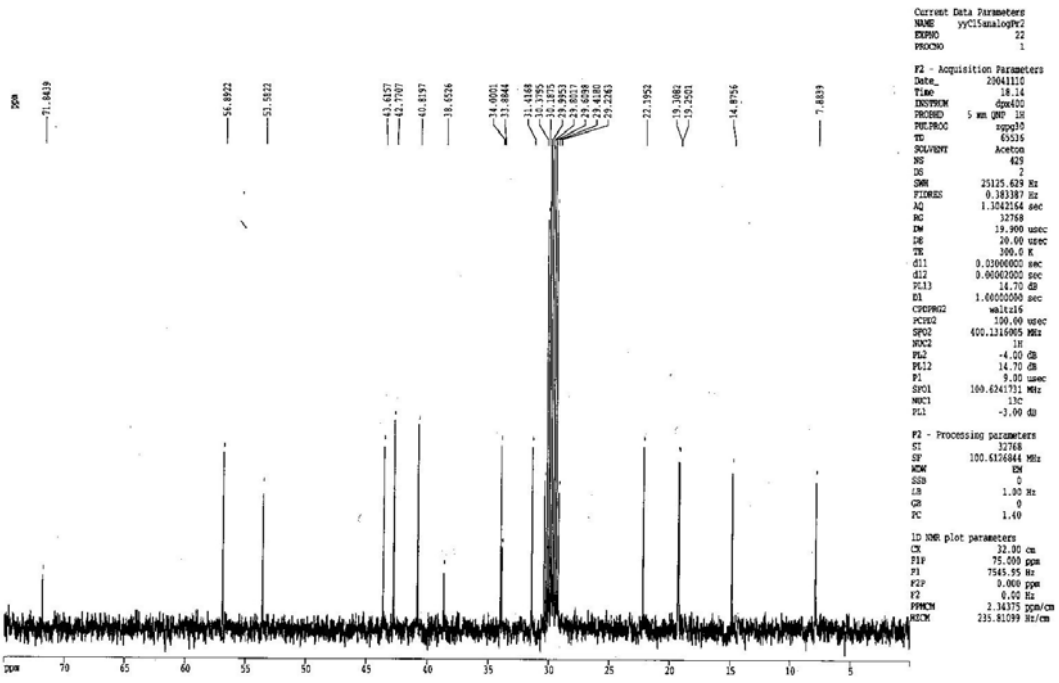
a, The two carbon signals are exchangeable due to the close values.

b This OH signal was observed in acetone d6, the chemical shift is expressed in relative to the solvent peak (2.04 ppm for 1H NMR)

(3) ^{1}H-NMR spectrum of product **18** in aceteone-d_6



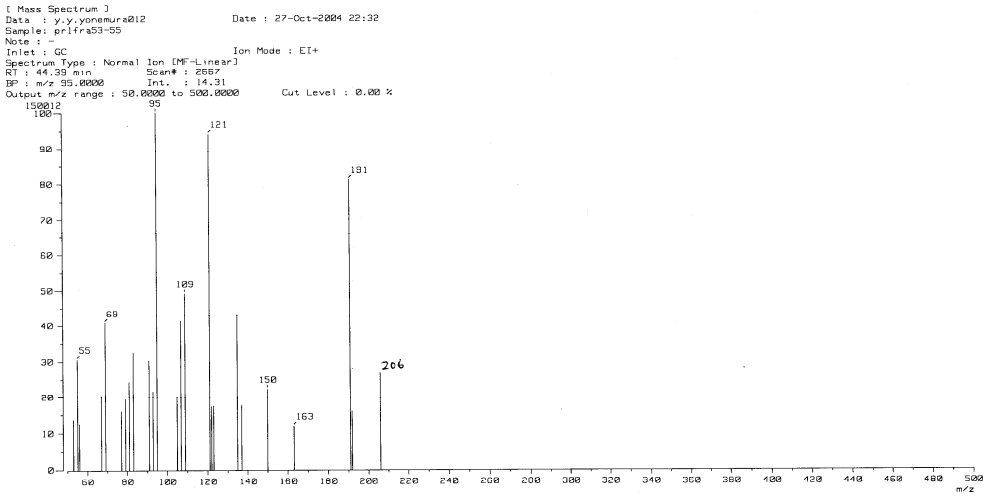
13C -NMR spectrum of product **18** in aceteone-d_6



7. Spectroscopic data of product 19

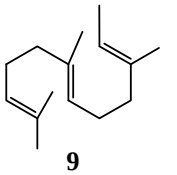
(1) EIMS spectrum of product **19**

(2) NMR data analyses and other data for **19**



S

Product **19** (drim-8(9)-ene)



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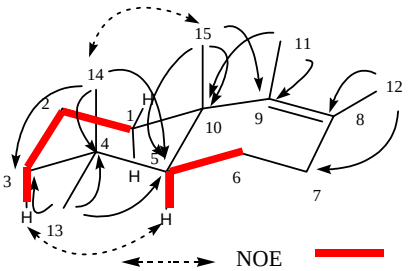
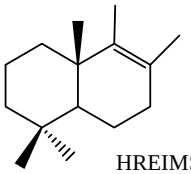


NOE COSY

HMBC



HREIMS M^+
Obserd: 206.2038
Calc.: 206.2035

$[\alpha]_D^{25}$= +22.7 (C_6H_6, c=0.01)
lit. value +62 (the solvent and concentration, not desribed); RM Carmans and W. Craig, Aust. J. Chem., 1971, **24,** 361-370.)

400 MHz, C_6D_6

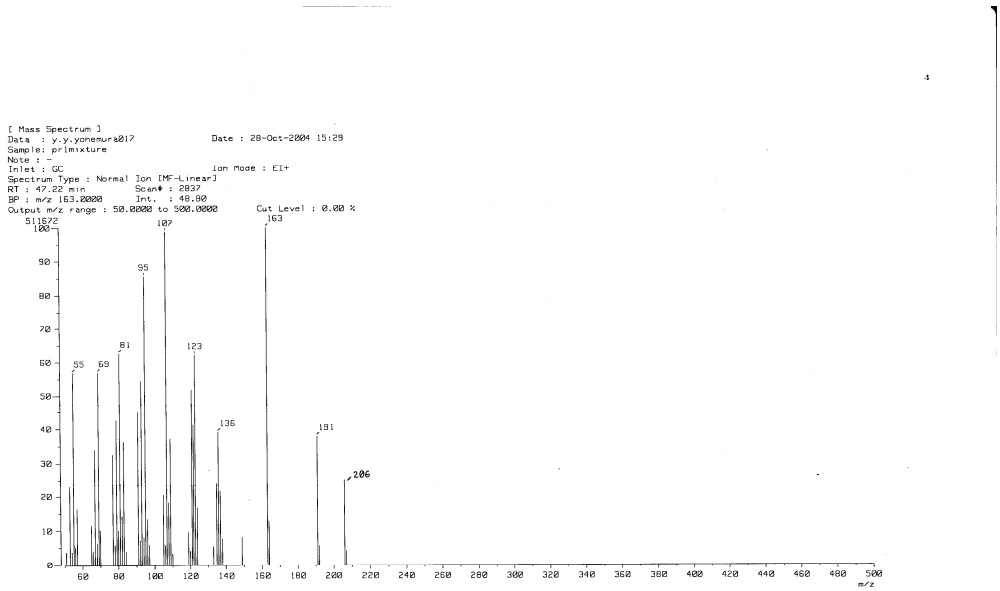
The solvent peaks: 7.28 ppm for ^{1}H-NMR; 128.0 ppm for ^{13}C-NMR

No	^{1}H	^{13}C	No	^{1}H	^{13}C
1	1.85 (m); 1.17(ddd, 12.8, 12.8, 3.6Hz)	**37.26**	**9**	——	**136.2**
2	1.73(m);1.52(m) *b*	**19.50** *a*	**10**	——	**38.50**
3	1.51 (m); 1.24 (m)	**42.03**	**11**	1.67 (3H, s)	**19.83**
4	——	**33.41**	**12**	1.67 (3H, s)	**19.83**
5	1.28 (m)	**51.85**	**13**	1.02 (3H, s)	**33.43**
6	1.73(m);1.52(m) *b*	**19.48** *a*	**14**	0.985 (3H, s)	**21.79**
7	2.10 (m); 1.53 (m)	**34.05**	**15**	1.12 (3H, s)	**19.50**
8	——	**124.3**			

The signals of *a* and *b* are indistinguishable due to the very close values.

8. Spectroscopic data of product 20

(1) EIMS spectrum of product **20**



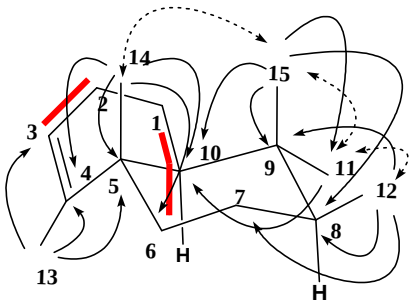
(2) NMR data analyses and other data for **20**

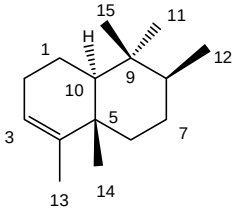
Product 20 (oil)

HRMS M^+
Observed:206.2040
Calculated:206.2035

$[\alpha]_D^{25} = -10.7\ (C_6H_6)$
$c=0.014\ (g/dl)$

NOESY
HMBC
COSY





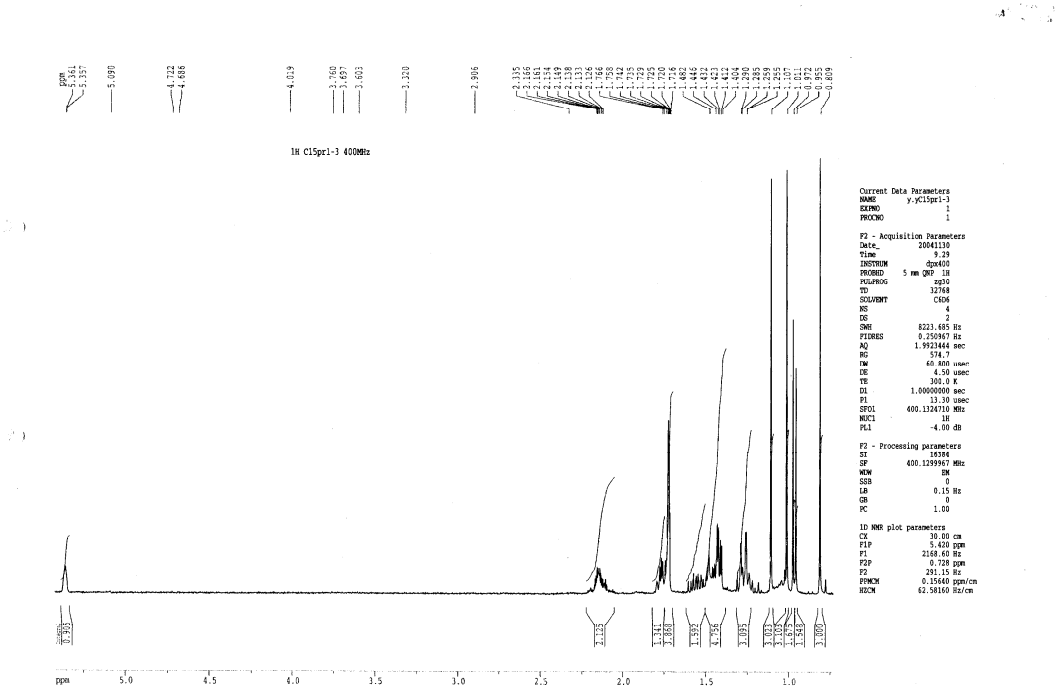
20:unnatural (20%)
(rearranged drimane skeleton)
like a clerodane diterpene skeleton, which was named quasiclerodane

Chemical shifts in C_6D_6 (400 MHz), relative to the solvent peak of C_6D_6:^{1}H 7.28ppm, ^{13}C 128.0ppm

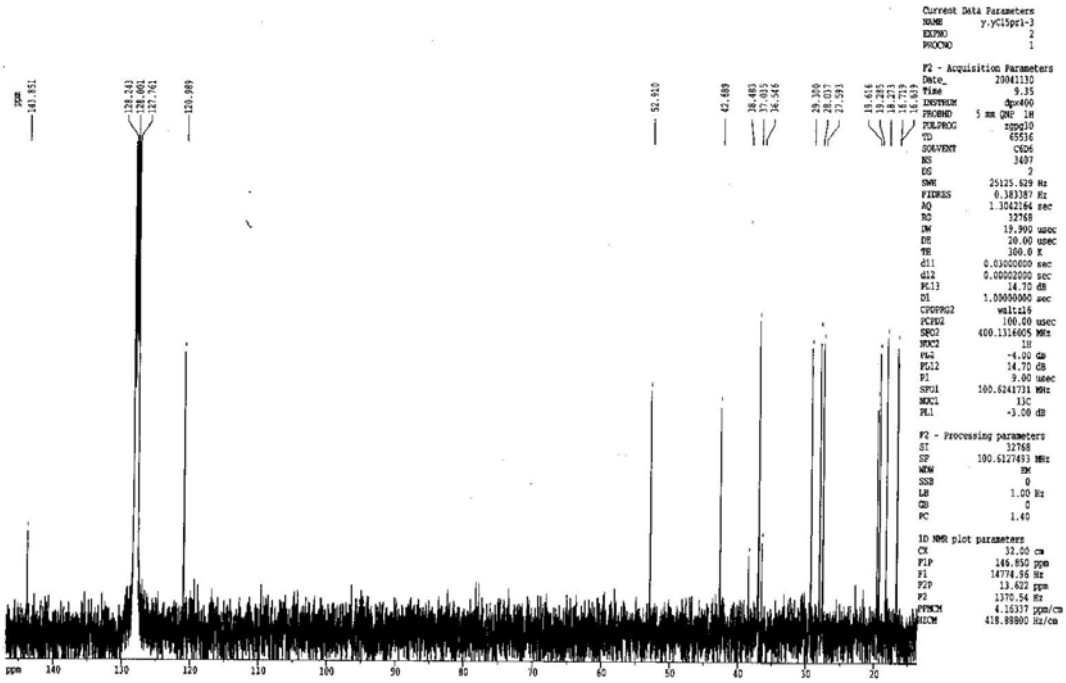
No	^{1}H	^{13}C	No	^{1}H	^{13}C
1	1.56 (m); 1.75 (m)	19.28	**9**	——	36.55
2	2.14 (2H, m)	27.59	**10**	1.27 (dd, 12.0,1.8Hz)	52.91
3	5.36 (br s)	120.99	**11**	1.011 (3H, s)	29.30
4	——	143.85	**12**	0.963 (3H, d, *J*=6.8Hz)	16.64
5	——	38.48	**13**	1.72 (d, *J*=1.2Hz)	18.27
6	1.27 (m); 1.72(m)	30.03	**14**	1.107 (3H, s)	19.62
7	1.28 (m); 1.42(m)	28.04	**15**	0.809 (3H, s)	16.72
8	1.24(m)	42.69			

The carbon signals of C12 and C15 may be interchangeable due to the close

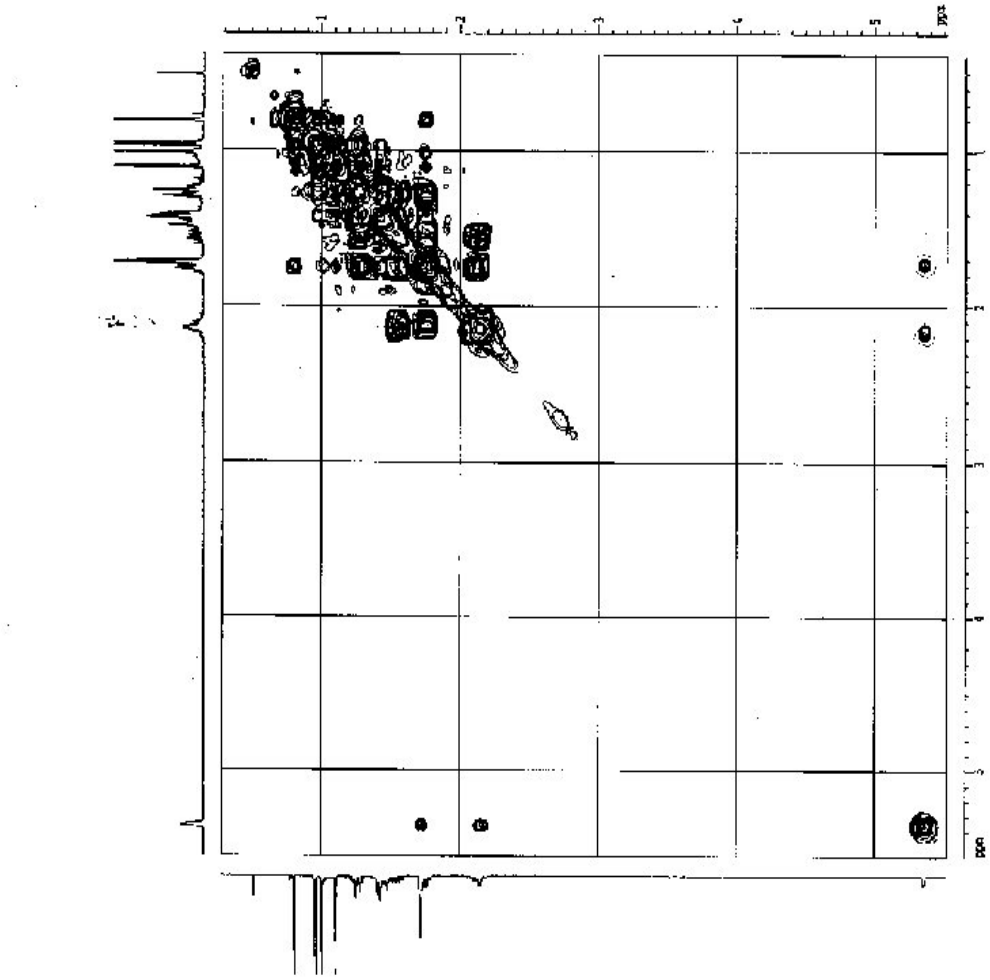
(3) ^{1}H-NMR spectrum of **20** in C_6D_6



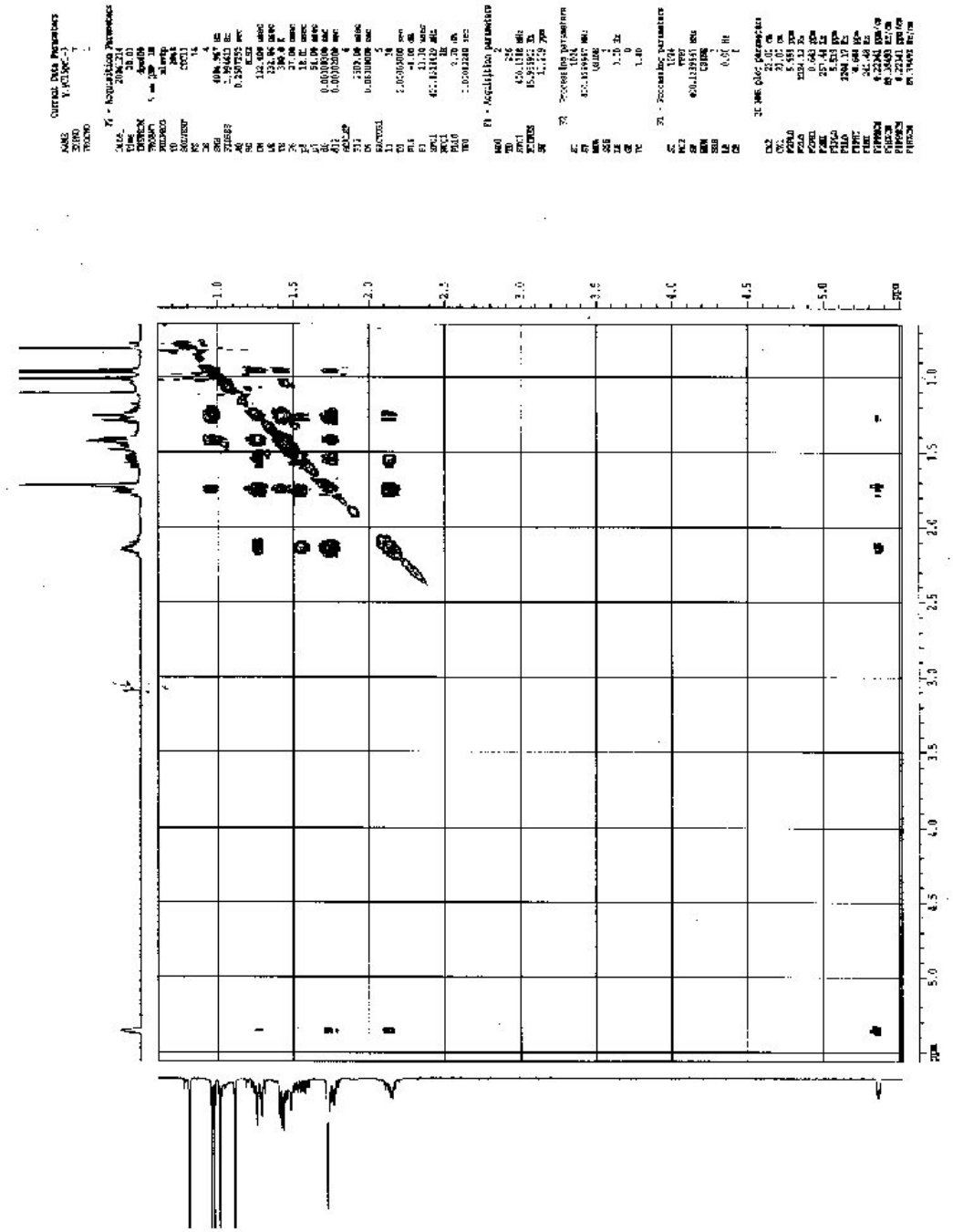
(4) ^{13}C-NMR spectrum of **20** in C_6D_6



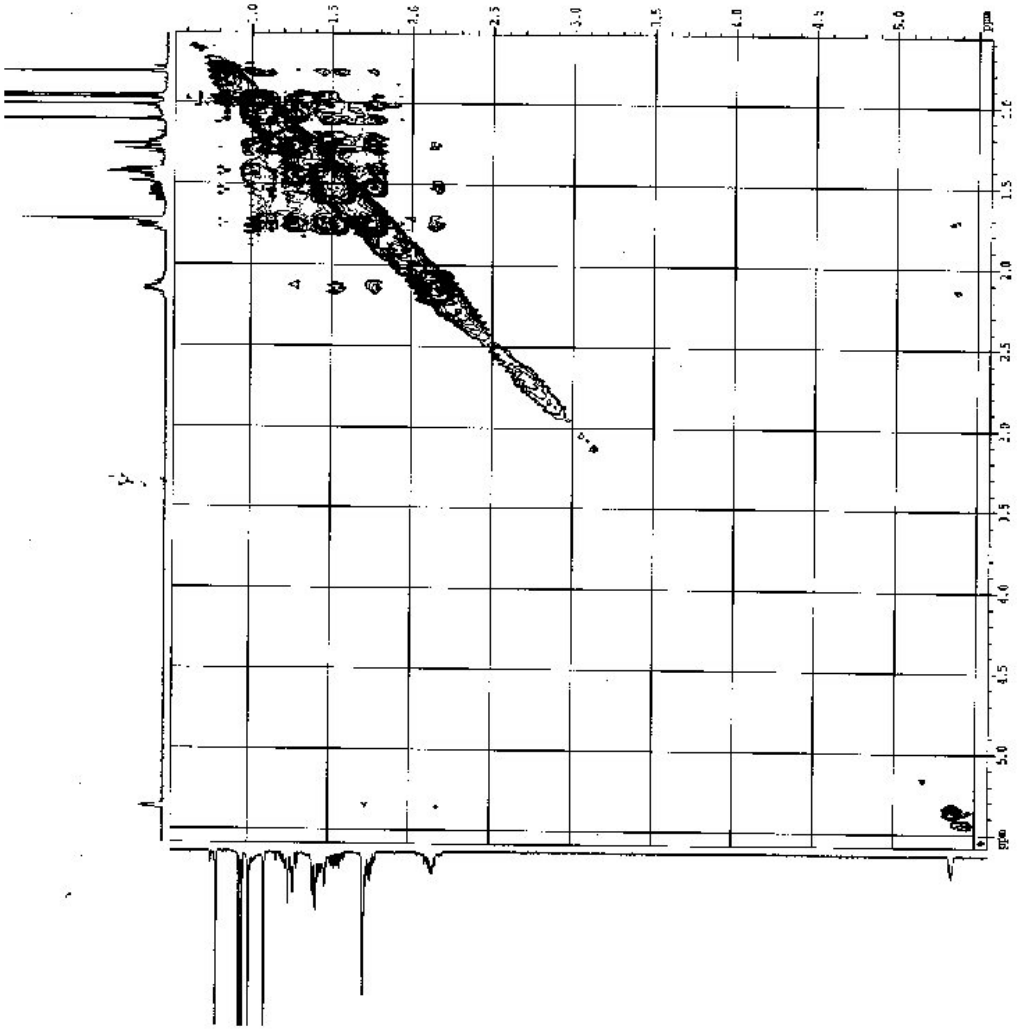
(5) ^{1}H-^{1}H COSY of product **20**



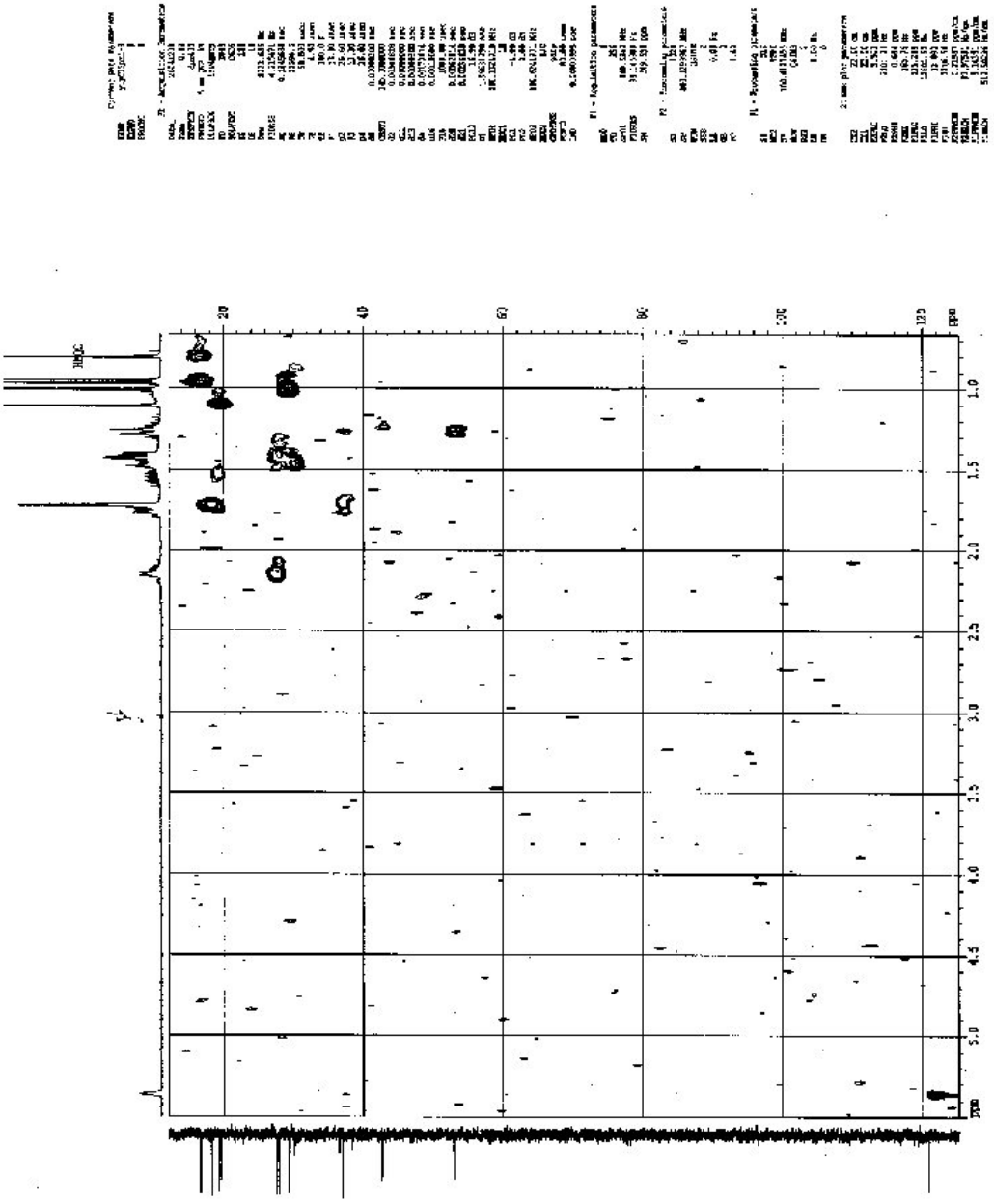
(6) HOHAHA spectrum of **20** in C_6D_6



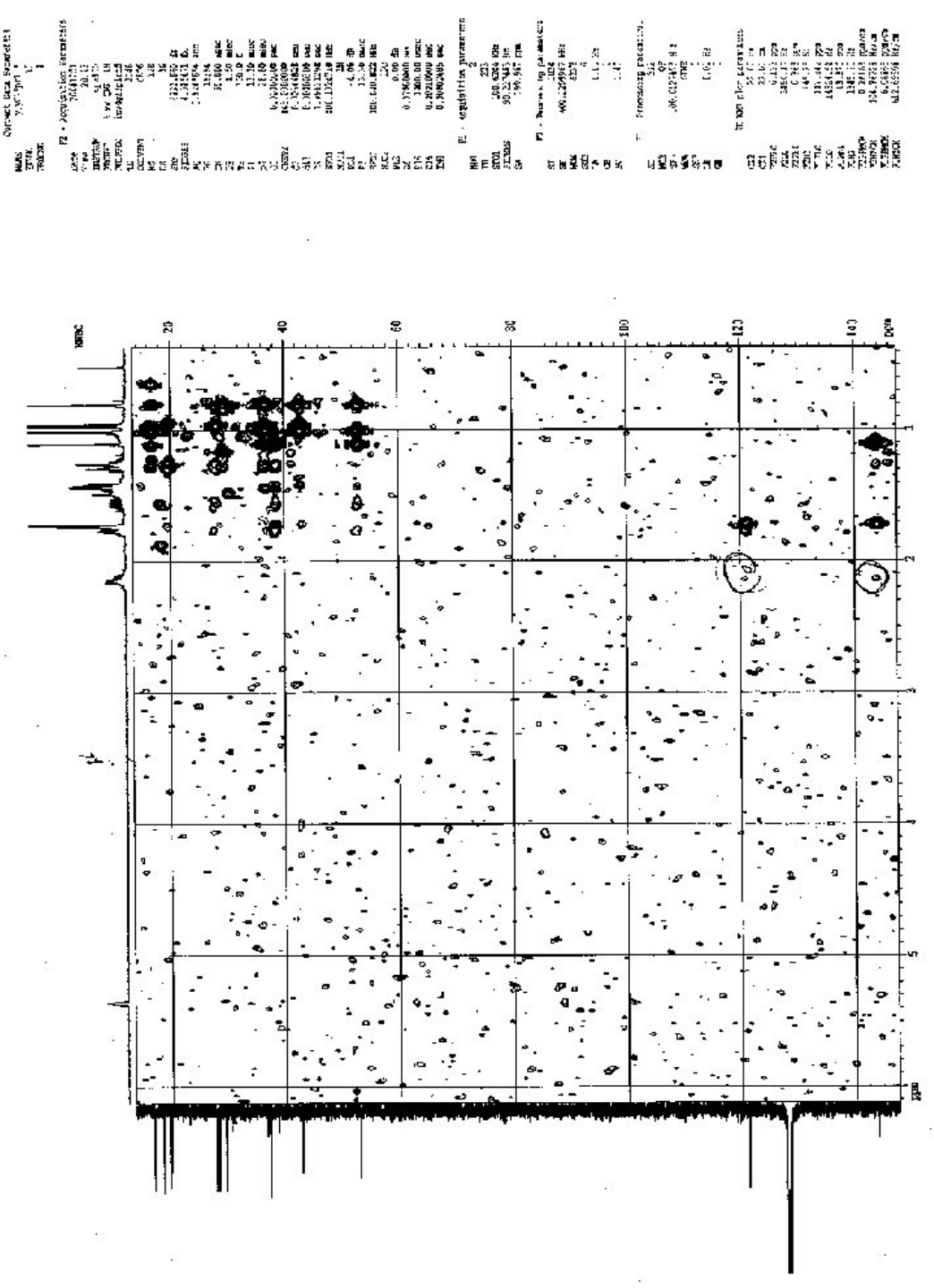
(7) NOESY spectrum of **20** in C_6D_6



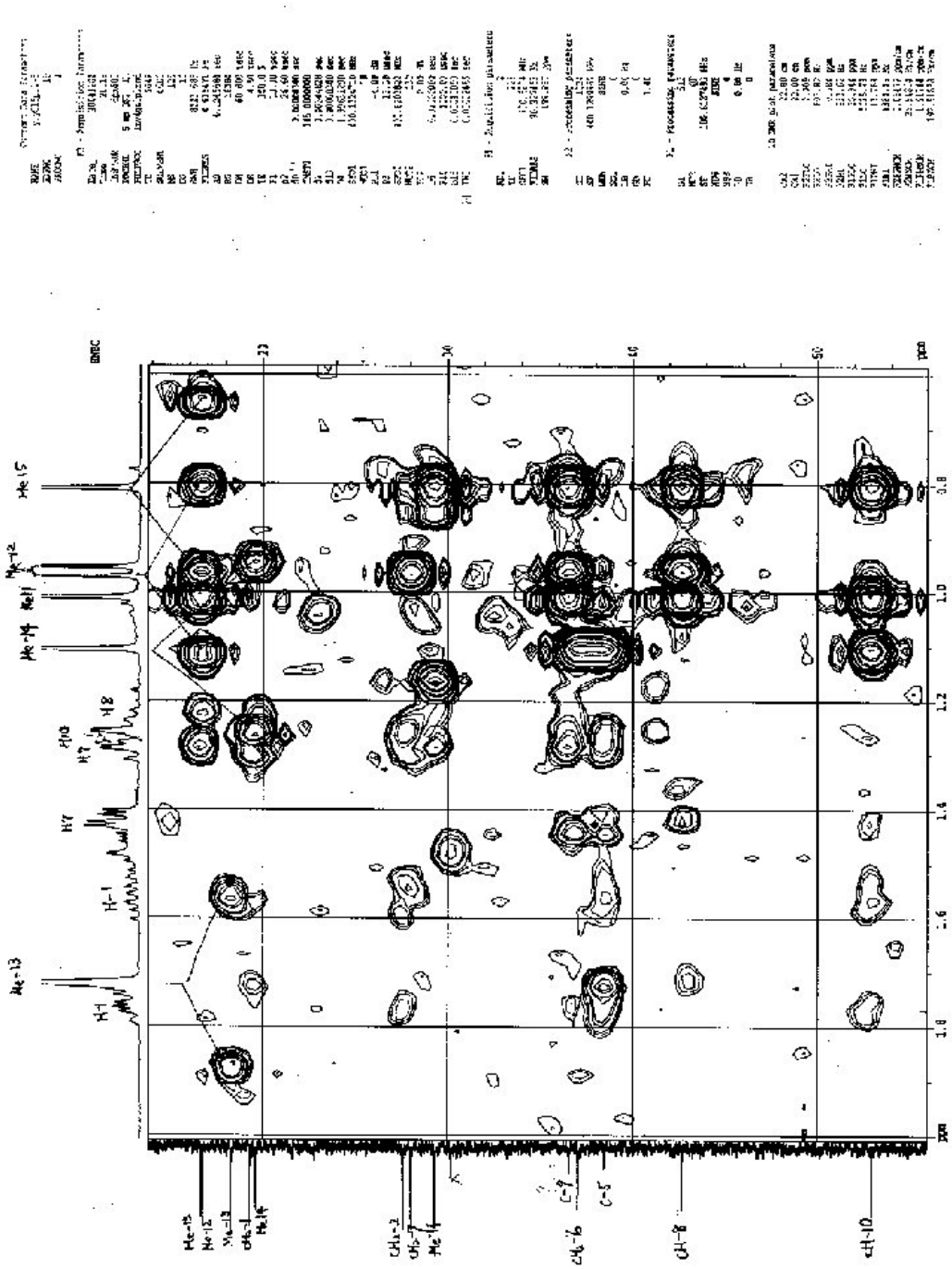
(8) HMQC spectrum of **20** in C_6D_6



(9) HMBC spectrum of **20** in C_6D_6

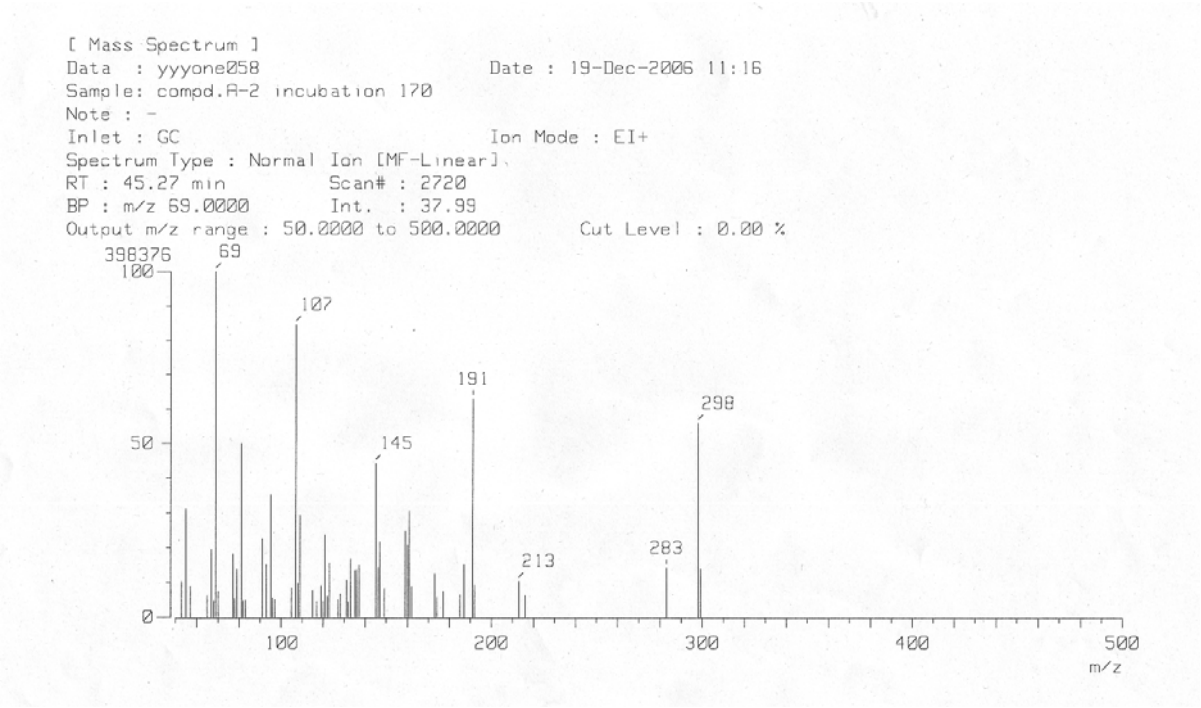


(10) HMBC spectrum (expanded region) of **20** in C_6D_6

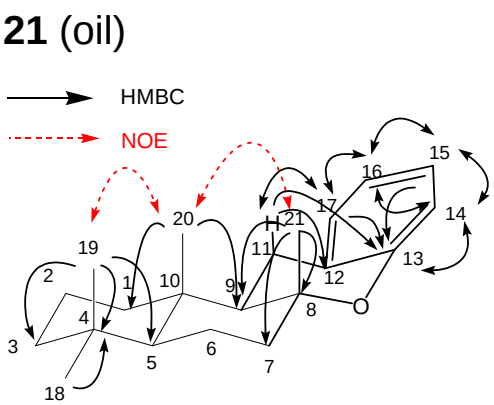


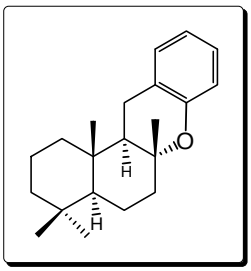
9. Spectroscopic data of product 21

(1) EIMS spectrum of product 21



(2) NMR data analyses and other spectral data of **21**



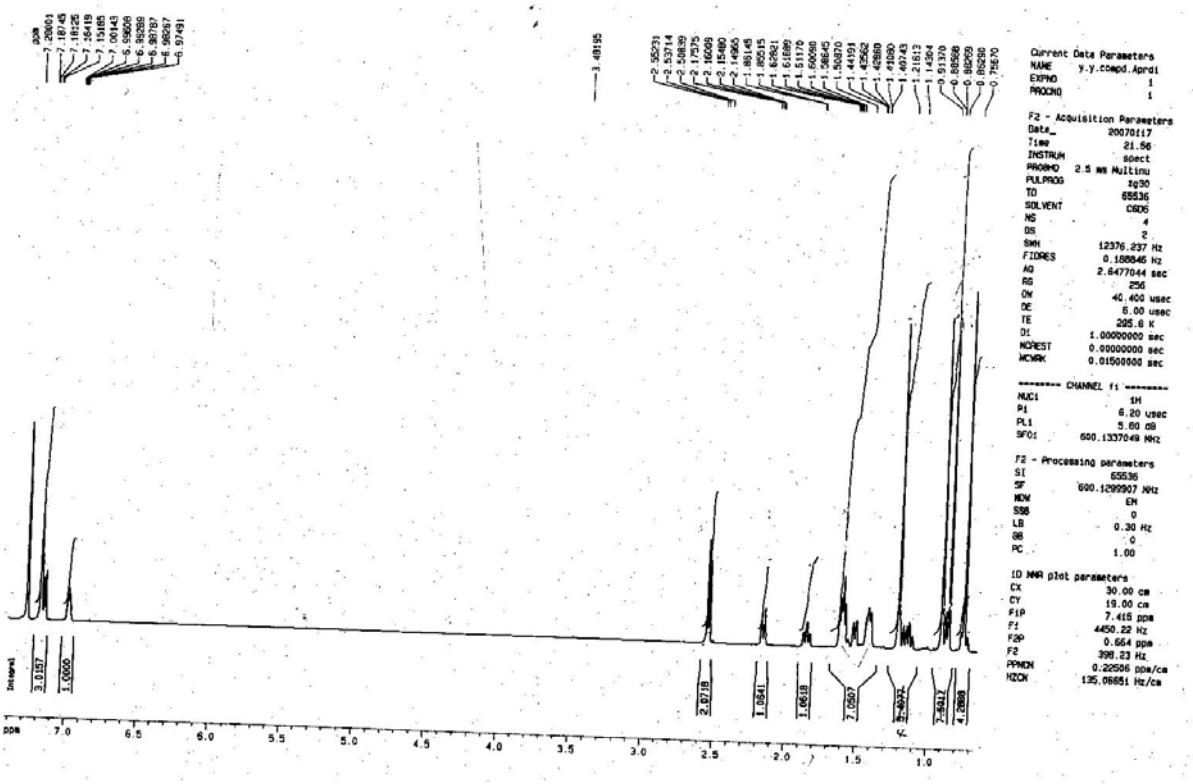


$[\alpha]_D^{25}$=+49.7 (c=0.4, $CHCl_3$)
HRMS M^+
Observed:298.2286
Calculated:298.2297

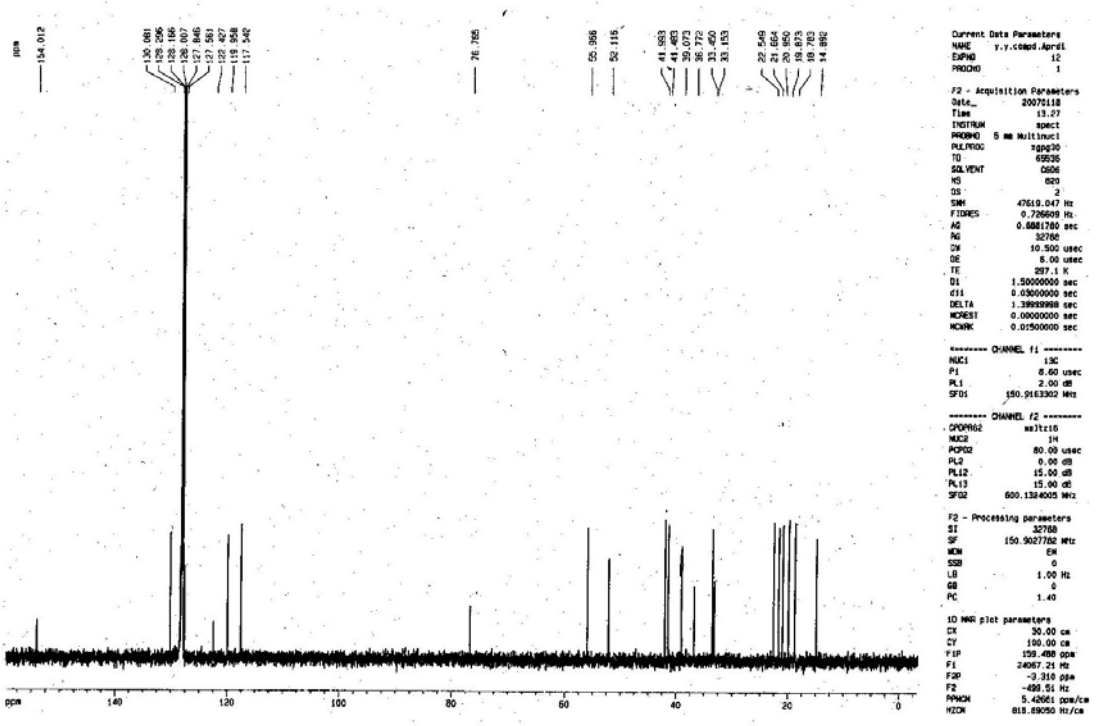
600 MHz NMR data, δppm in C_6D_6 relative to C_6D_6 : ^1H ; 7.28 ppm , ^{13}C ; 128.0 ppm

NO.	^1H	^{13}C	NO.	^1H	^{13}C	NO.	^1H	^{13}C
1	1.52(bd,12.2Hz);0.74(m)	**39.07**	8	—	**76.77**	15	7.18(m)	**117.5**
2	1.63(m);1.44(m)	**19.87**	9	1.59(m)	**52.12**	16	7.18(m)	**127.6**
3	1.41(m);1.14(m)	**41.99**	10	—	**36.77**	17	7.16(bd.*J*=7.6Hz)	**130.1**
4	—	**33.15**	11	2.54(2H,d,9.0Hz)	**22.55**	18	0.914(3H,s)	**33.45**
5	0.89(m)	**55.97**	12	—	**122.4**	19	0.863(3H,s)	**21.66**
6	1.60(m);1.23(m)	**18.73**	13	—	**154.0**	20	0.757(3H,s)	**14.89**
7	1.86 (ddd, *J*=13.0, 13.0, 4.0 Hz); 2.16 (ddd. *J*=12.5, 3.2, 3.2 Hz)	**41.48**	14	6.99(m)	**119.9**	21	1.216(3H,s)	**20.95**

(3) ^{1}H-NMR spectrum of product **21**

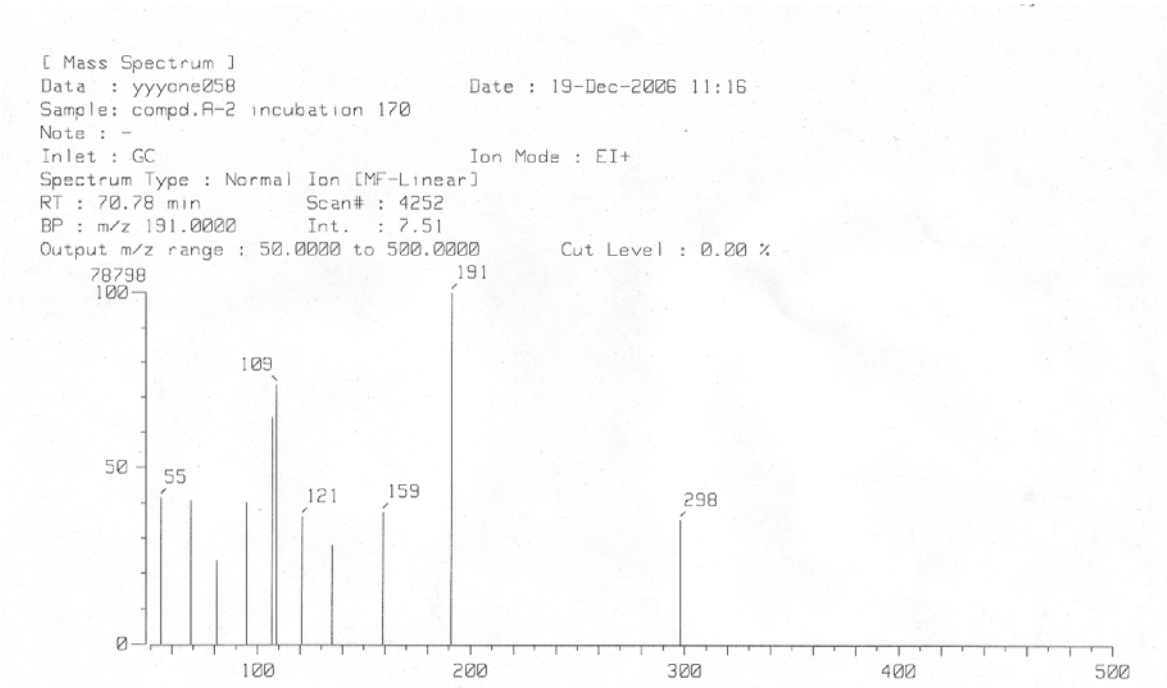


(4) ^{13}C-NMR spectrum of product **21**



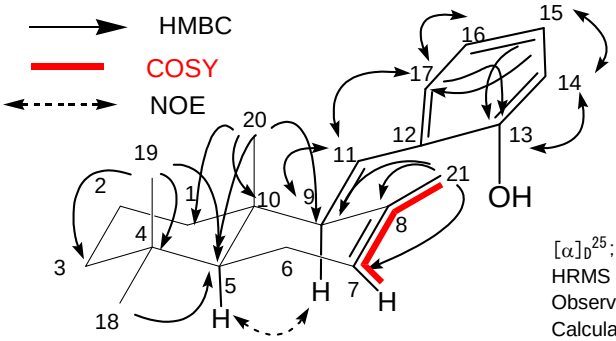
10. Spectroscopic data of product 22

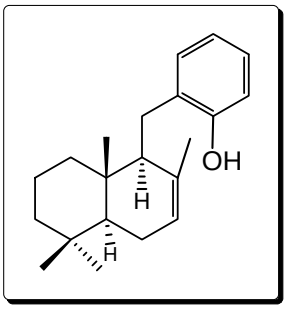
(1) EIMS spectrum of Product **22**



(2) NMR data analyses and other data of product **22**

22 (oil)



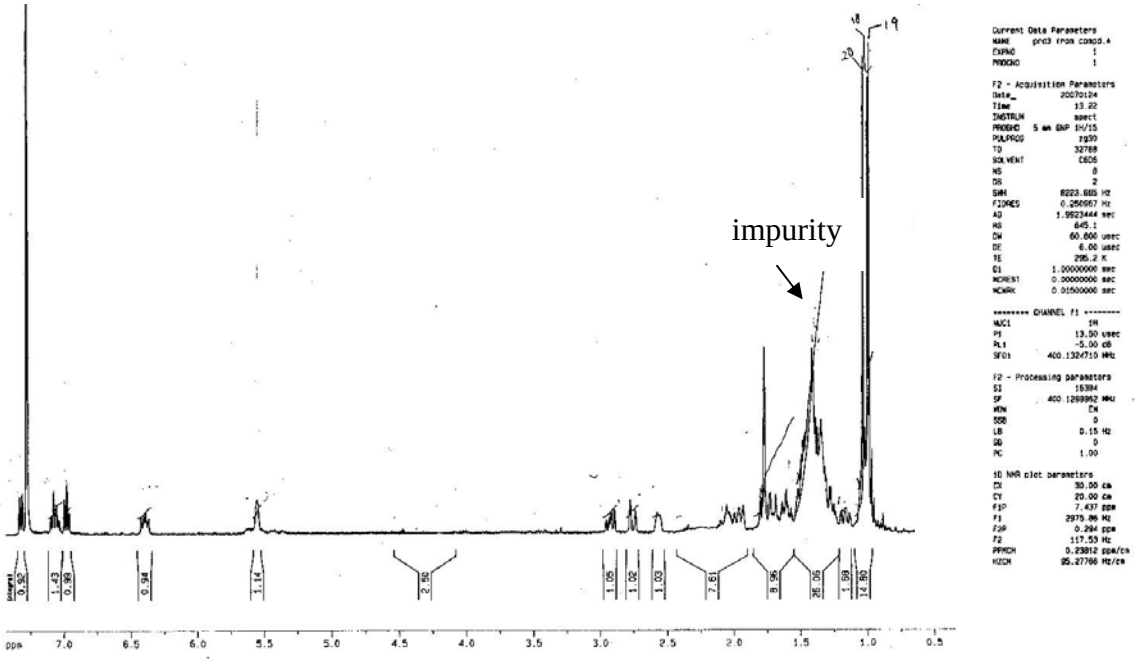


$[\alpha]_D^{25}$: not determined due to very small amount
HRMS M^+
Observed:298.2292
Calculated:298.2297

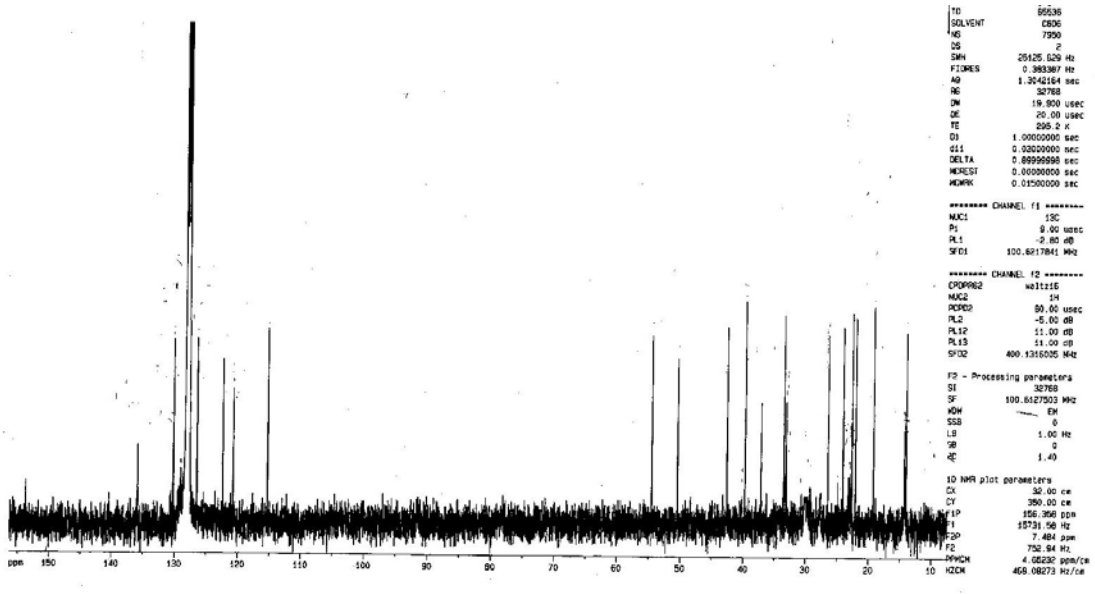
400 MHz NMR data, δ ppm in $CDCl_3$ relative to $CDCl_3$: ^1H ; 7.26 ppm , ^{13}C ; 77.0 ppm

NO.	^1H	^{13}C	NO.	^1H	^{13}C	NO.	^1H	^{13}C
1	1.94(bd,11.6Hz); 1.17(ddd, 3.6,13.2,13.2Hz)	**39.72**	8	—	**135.8**	15	7.08 (t, 7.6 Hz)	**127.7**
2	1.60)m): 1.30 (m)	**19.30**	9	2.56(bd, *J*=8.0 Hz)	**54.51**	16	6.98(t,7.6Hz)	**120.7**
3	1.53(m);1.31(m)	**42.58**	10	—	**37.17**	17	7.32 (d, 7.6 Hz)	**130.2**
4	—	**33.16**	11	2.93(m); 2.76(d,15.2Hz)	**26.49**	18	1.01(3H,s)	**33.47**
5	1.41(m)	**50.45**	12	—	**130.3**	19	0.998(3H,s)	**22.13**
6	2.08(2H, m)	**24.97**	13	—	**153.8**	20	1.04(3H,s)	**14.09**
7	5.57(bs)	**122.4**	14	6.39 (m)	**115.3**	21	1.77(3H,s)	**22.69**

(3) ^{1}H-NMR spectrum of product **22**

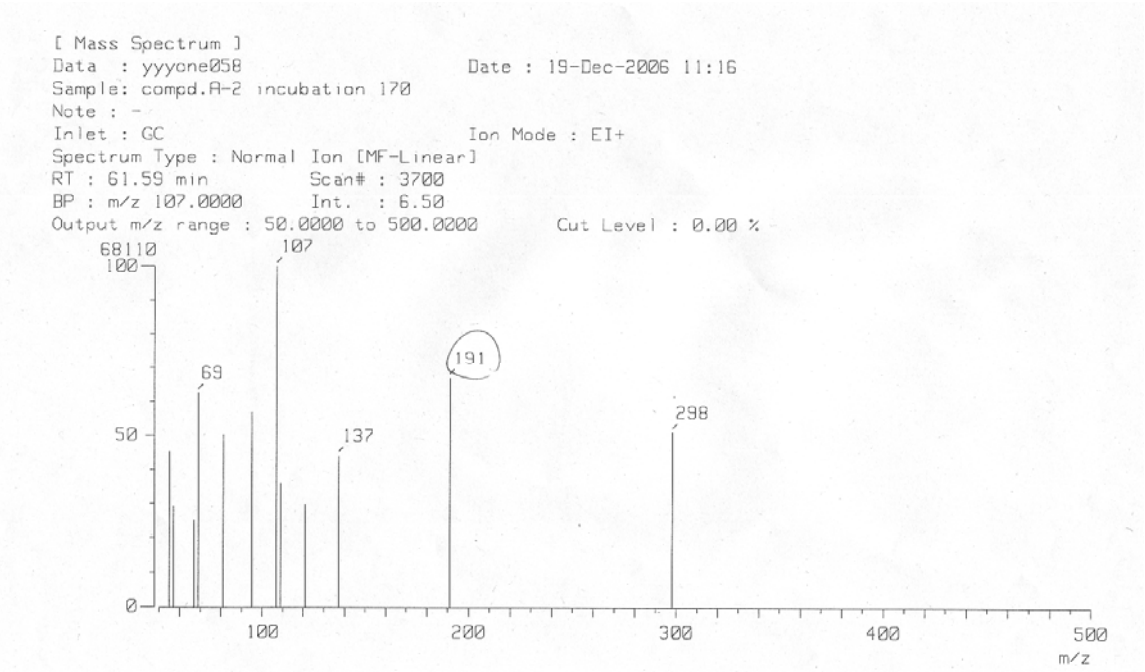


(4) ^{13}C-NMR spectrum of product **22**



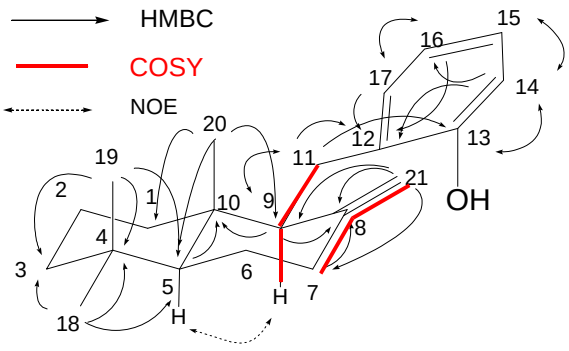
11.Spectroscopic data of product 23

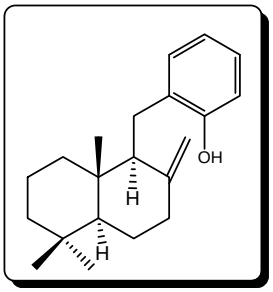
(1) EIMS spectrum of Product **23**



(2) NMR data analyses and other data of product **23**

23 (oil)



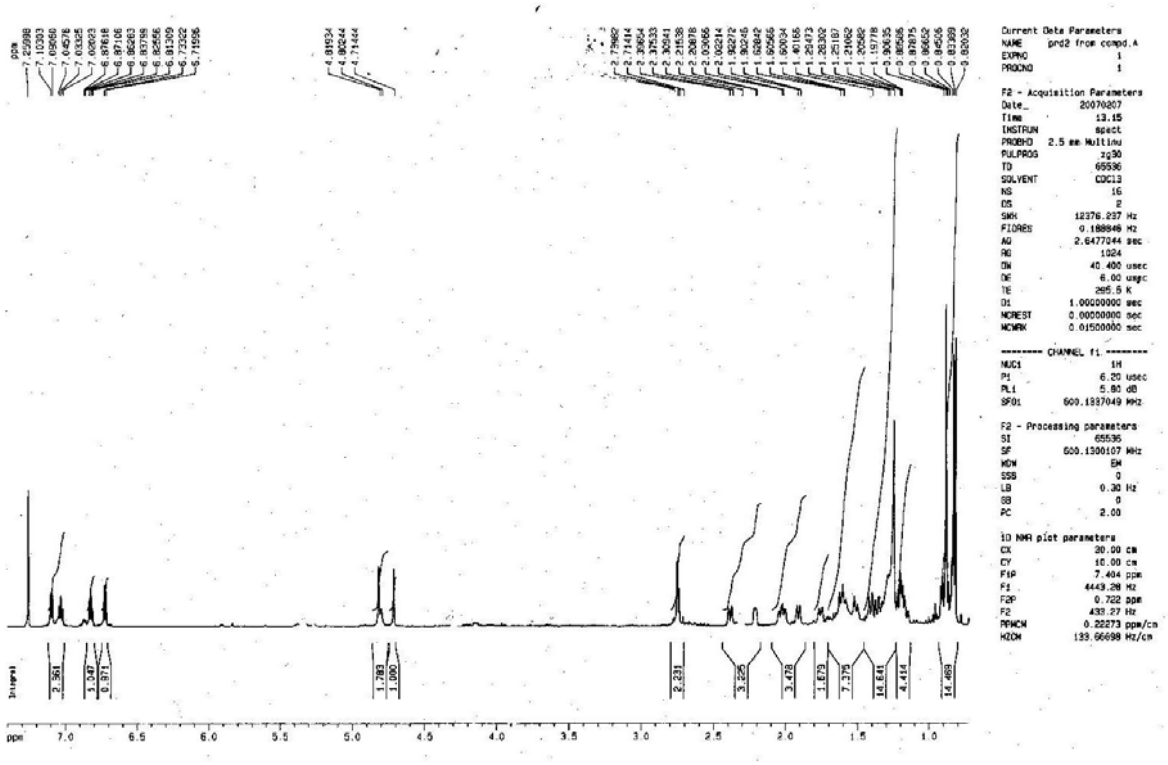


$[\alpha]_D^{25}$; not determined due to very small amount
HRMS M^+
Observed:298.2292
Calculated:298.2297

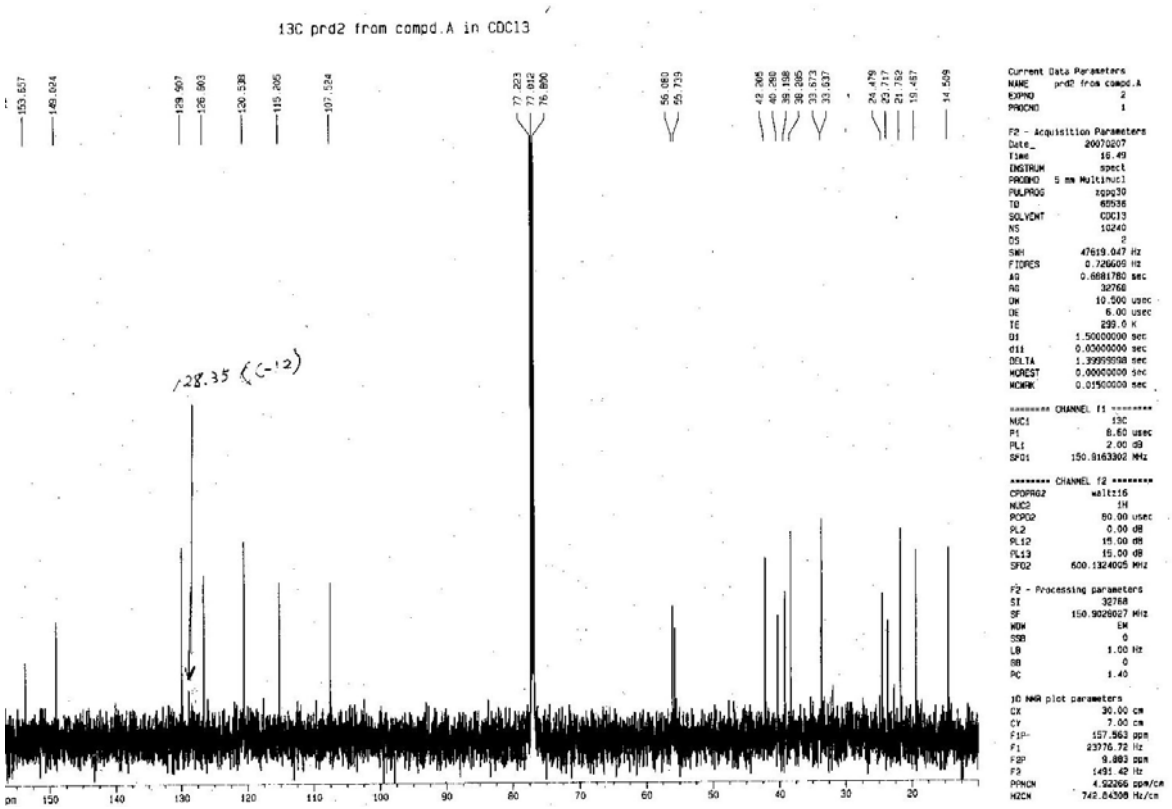
600 MHz NMR data, δppm in $CDCl_3$ relative to $CDCl_3$: 1H ; 7.26 ppm , 13C ; 77.0 ppm

NO.	^{1}H	^{13}C	NO.	^{1}H	^{13}C	NO.	^{1}H	^{13}C
1	1.91(d,12.0Hz);1.17(m)	**39.20**	8	—	**149.0**	15	**7.03(t,7.51Hz)**	**126.6**
2	1.63(m);1.52(m)	**19.47**	9	2.22(br m)	**56.08**	16	6.83(t,7.5Hz)	**120.5**
3	1.41(d,12.0Hz);1.19(m)	**42.21** [a]	10	—	**40.29**	17	7.10 (d,7.5Hz)	**129.9**
4	—	**33.67**	11	2.75(2H, d,8.8 Hz)	**23.71**	18	0.885(3H,s)	**33.64** [a]
5	1.20(m)	**55.74**	12	—	**128.3**	19	0.834(3H,s)	**21.76**
6	1.76(m);1.37(m)	**24.48**	13	—	**153.6**	20	0.820(3H,s)	**14.51**
7	2.38(d,12.7Hz); 2.03(ddd,4.2,12.7,12.7)	**38.29**	14	6.72 (d,7.5Hz)	**115.2**	21	4.82(s); 4.71(s)	**107.5**

(3) ^{1}H-NMR spectrum of product **23**

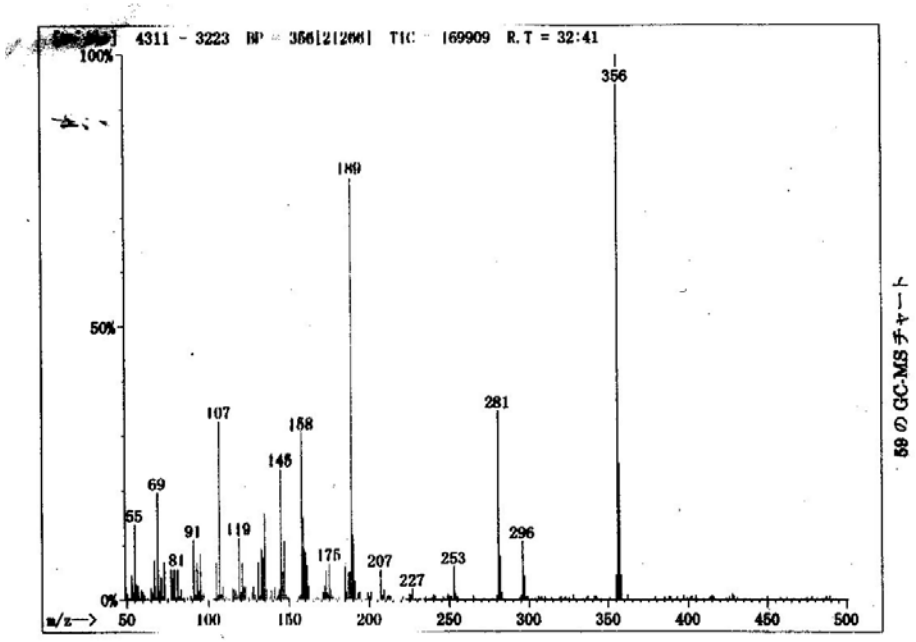


(4) ^{13}C-NMR spectrum of product **23**



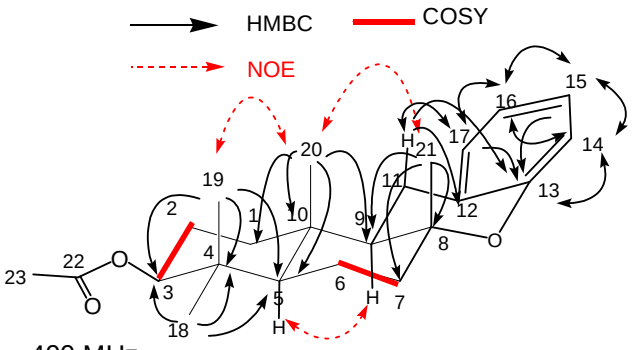
12.Spectroscopic data of product 24-acetate (25)

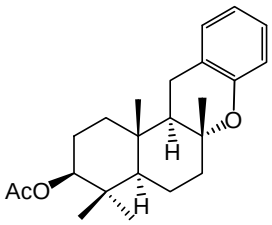
(1) EIMS Spectrum of Prduct **24**-Acetate (**25**)



(2) NMR data analyses and other data of product **24 acetate**

24-acetate





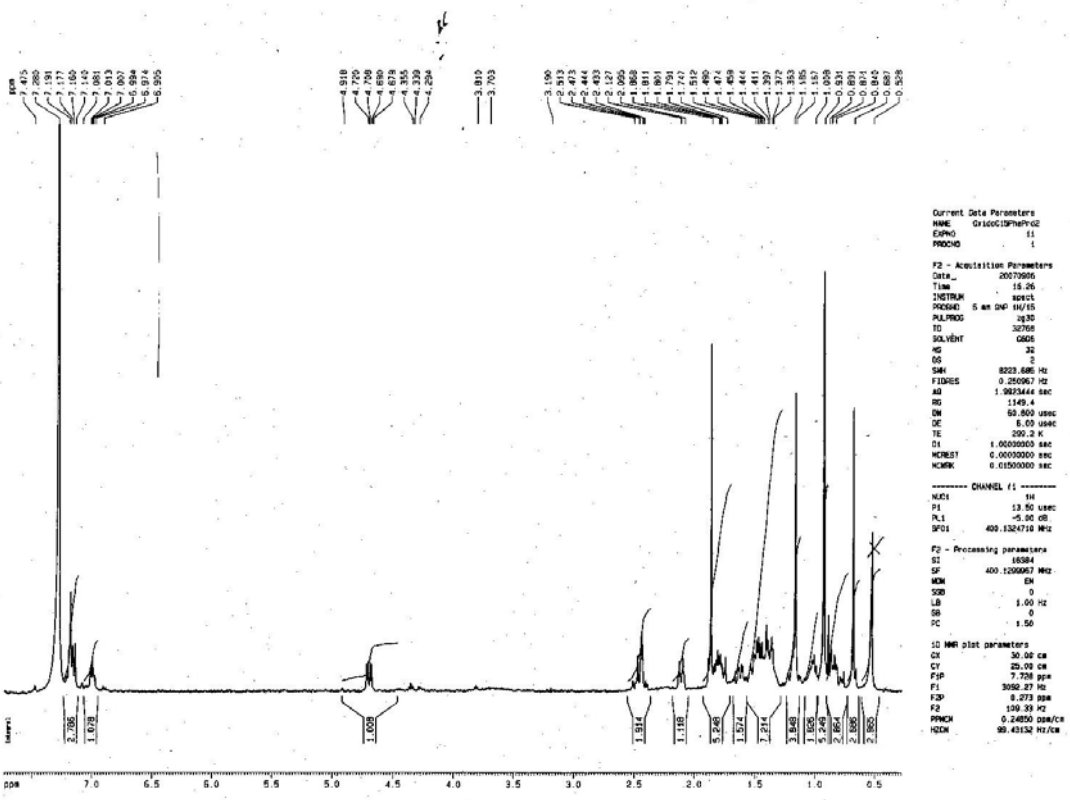
$[\alpha_{JD}^{25}$=+25.5 (c=0.1, $CHCl_3$)
HRMS M^+
Observed:356.2357
Calculated:356.2351 FOR $C_{23}H_{32}O_3$

400 MHz NMR data, δ ppm in C_6D_6 relative to C_6D_6 : ^1H ; 7.28 ppm , ^{13}C ; 128.0 ppm

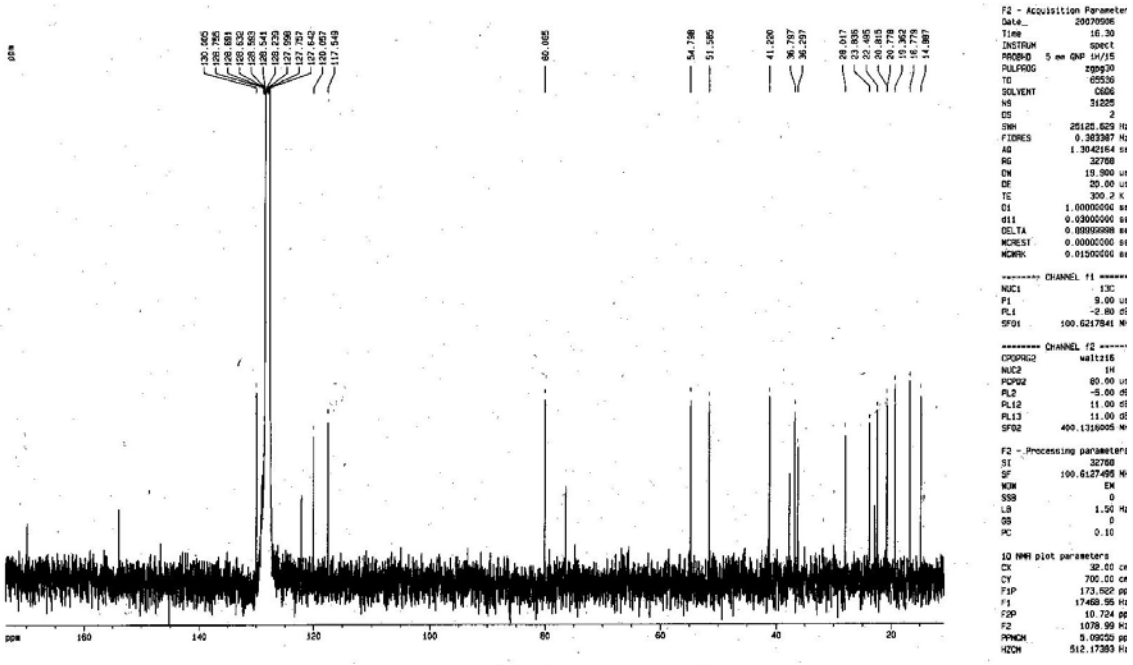
NO.	^1H	^{13}C	NO.	^1H	^{13}C	NO.	^1H	^{13}C
1	1.37 (m); 0.83 (m)	**36.80**	8	—	**76.43**	15	7.18(m)	**117.5**
2	1.82(m);1.64(m)	**23.84**	9	1.47(m)	**51.59**	16	7.18(m)	**127.6**
3	4.70 (dd, 12.0, 4.8 Hz)	**80.06**	10	—	**36.30**	17	7.15(bd.*J*=8.0Hz)	**130.0**
4	—	**37.76**	11	2.44 (2H, m)	**22.49**	18	0.931(3H,s)	**28.02**
5	0.86(m)	**54.80**	12	—	**122.4**	19	0.931(3H,s)	**16.78**
6	1.52 (2H, m)	**19.36**	13	—	**154.0**	20	0.687(3H,s)	**14.88**
7	2.13(m); 1.79 (m)	**41.22**	14	6.99(m)	**120.0**	21	1.167 (3H, s	**20.77**[a]
						22	—	169.8
						23	1.87 (3H, s)	**20.81**[a]

The carbon signals marked with *a* may be exchangeable.

(3) ^{1}H-NMR spectrum of product **24** acetate (**25**)

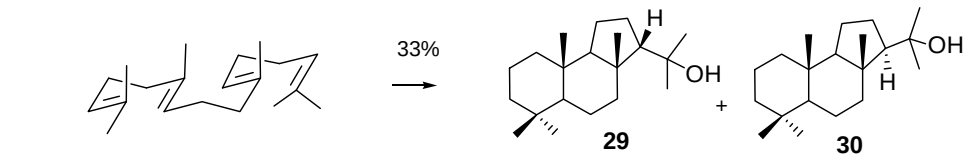


(4) ^{13}C-NMR spectrum of pectrum of product **24** acetate (**25**)

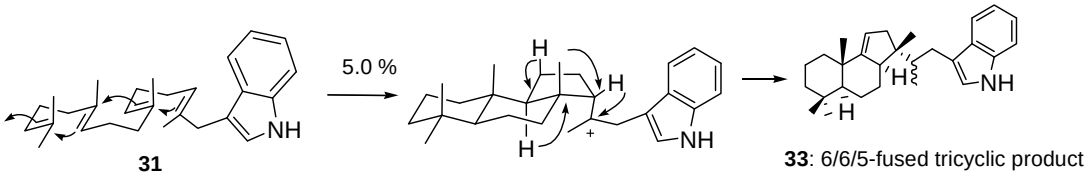


13. Polycyclization reactions of 28, 31 and 32 by SHC enzyme.

28: R=H, complete cyclized product (33% yield)
31: R=indole, 6/6/5-fused tricyclic **33** and 6/6-fused-bicyclic products**34** (7.5% yield)
32: R=pyrrole, 6/6/5-fused tricyclic **35** and 6/6-fused-bicyclic products **36** (1.1% yield)

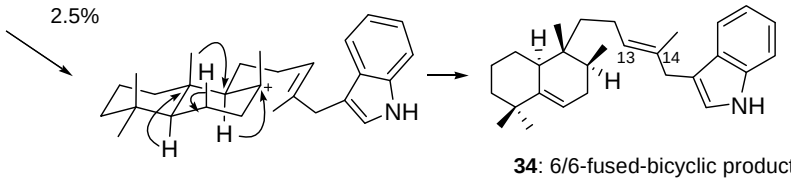


29 **30**



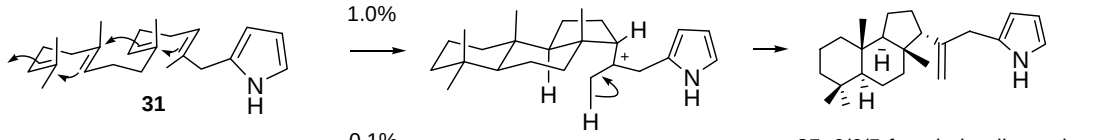
31

33: 6/6/5-fused tricyclic product



34: 6/6-fused-bicyclic product

Remark: The double bond at C13-C14 must be of *E*-geometry, but the following original paper was erroneously depicted in *Z*-form (H. Tanaka et a., *Org. Lett.*, 2005, **7**, 5873-5876 (ref. 26).



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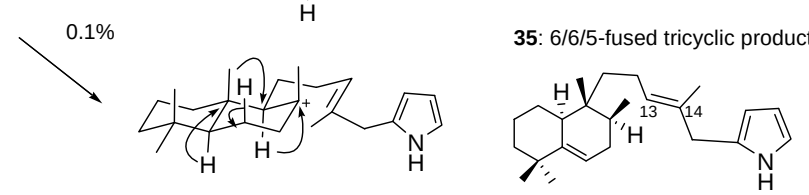
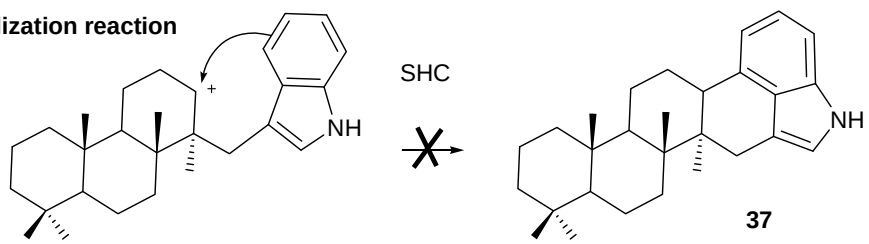
35: 6/6/5-fused tricyclic product



36: 6/6-fused-bicyclic product

Remark: The double bond at C13-C14 must be of *E*-geometry, but the following original paper was erroneously depicted in *Z*-form (H. Tanaka et a., *Tetrahedron Lett.*, 2006, **47**, 3085-3089 (ref. 27).

Full cyclization reaction



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