REFERENCES

1. Sariaslani, F. S., Rosazza, J. P. N. 1984. Biocatalysis in natural products chemistry. Enzyme Microb. Technol. 6: 242-252.
2. Plimmer, R. H. A. 1903. The Chemical Changes and Products Resulting From Fermentation Longmans, Green and London.
3. หลวงประเสริฐวิทยาศาสตร์. 2530. ตำราสรรพคุณยาไทย กรุงเทพมหานคร: ชุติมาการพิมพ์, หน้า 101.
4. Roengsumran, S., Achayindee, S., Petsom, A., Pudhom, K., Singtothong, P., Surachetapan, C., and Vilaivan, T. 1998. Two new cembranoids from *Croton oblongifolius* Roxb. J. Nat. Prod. 61: 652-654.
5. Roengsumran, S., Petsom, A., Sommit, D., and Vilaivan, T. 1999. Labdane diterpenoids from *Croton oblongifolius* Roxb. Phytochemistry 50(3): 449-453.
6. Roengsumran, S., Petsom, A., Kuptiyanuwat, N., Vilaivan, T., Ngamrojanavanich, C., Chaichantiyuth, C., and Phuthong, S. 2001. Cytotoxic labdane diterpenoids from *Croton oblongifolius* Roxb. Phytochemistry 56(1): 103-107.
7. Ghisalberti, E. L. 1997. The biological activity of naturally occurring kaurane diterpenes. Fitoterapia 68(4): 303-325.
8. Ngamrojanavanich, N., Sirimongkon, S., Roengsumran, S., Petsom, A., Kamimura, H. 2003. Inhibition of Na^+,K^+-ATPase activity by (-)-ent-kaur-16-en-19-oic acid and its derivatives. Planta Medica. 69: 555-556.
9. Chaichantipyuth, C., Petsom, A., Taweechotipatr, P., Muangsin, N., Chaichit, N., Puthong, S., Roengsumran, S., Kawahata, M., Watanabe, T., Ishikawa, T. 2005. New labdane-type diterpenoids from *Croton oblongifolius* and their cytotoxic activity. Heterocycles. 65(4): 809-822.
10. Fujita, E., Node, M. 1984. Progress in the Chemistry of Organic Natural Products 46: 77.
11. Beilby, J. P., Ghisalberti, E. L., Jefferies, P. R., Sefton, M. A., Sheppeard, P. N. 1973. Microbiological transformation of tatracyclic diterpenes. Tetrahedron Lett. 28: 2589-2592.

12. Ghisalberti, E. L., Jefferies, P. R., Sefton, M. A., Sheppeard, P. N. 1977. Microbiological transformation of 19-oxygenated ent-kaurenes. Tetrahedron. 33: 2451-2456.

13. Hanson, J. R.; White, A. F. 1968. The transformation of steviol by *Gibberella fujikuroi*. Tetrahedron. 24: 6291-6293.

14. Silva, E. A., Takahashi, J. A., Boaventura, M. A. D., Oliveira, A. B. 1999. The biotransformation of *ent*-kaur-16-en-19-oic acid by *Rhizopus stolonifer*. Phytochemistry 59: 397-400.

15. Vieria, H. S., Takahashi, J. A., Boaventura, M. A. D. 2000. Biotransformation of methyl ent-17-hydroxy-16β-kauran-19-oate by *Rhizopus stolonifer*. App. Micro. Biotech. 53: 601-604.

16. Punnapayak, H., Pechwang, J., Chaichit, N., Jaiboon, N., Pornpakakul, S., Petsom A. 2002. Crystal structure of *ent*-(7β,11α)-dihydroxy-1-oxo-kaur-16-en-19-oic acid, $C_{20}H_{28}O_5$. Z. Kristallogr. NCS. 217: 603-604.

17. Garcia-Granados, A., Jimenez, M. B., Martinez, A., Parra, A., Rivas, F., Arias, J. M. 1994. Chemical-microbiological synthesis of *ent*-13-*epi*-manoyl oxides with biological activities. Phytochemistry 37(3): 741-747.

18. Garcia-Granados, A., Jimenez, M. B., Martinez, A., Parra, A., Rivas, F., Arias, J. M. 1995. Preparation of polyoxygenated *ent*-13-*epi*-manoyl oxides by chemical-microbiological semisyntheses. Phytochemistry 38(5): 1237-1244.

19. Fraga, B. M., Hernandez, M. G., Gonzalez, P., Lopez, M., Suarez, S. 1999. Formation of 2,3-*seco*-acids in the biotransformation of the diterpene ribenone by *Gibberella fujikuroi*. Tetrahedron 55: 1781-1792.

20. Fraga, B. M., Hernandez, M. G., Gonzalez, P., Lopez, M., Suarez, S. 2001. Biotransformation of the diterpene ribinone by *Mucor plumbeus*. Tetrahedron 57: 761-770.

21. John, B., Kristiansen, B. 1987. Basic Biotechnology Academic Press. 463-482.

22. Wang, D. I. C., Cooney, G. L., Demain, A. L., Dunnill, P., Humphrer, A. E., Lilly, M. D. 1979. Fermentation and Enzyme Technology John Wiley & Son. 37-45.

23. Prave, P., Faust, U., Sittig, W., Sakatsch, D. A. 1987. "Biotransformation" Fundamentals of Biotechnology VOH Verlagsgesellschaft mbH. 564-600.

24. Fogarty, W. M., Kelly, C. T. 1990. Transformation of Antibiotic and Steroids. Microbial Enzyme and Biotechnology Elsevier Science Publishing CO. INC.

25. Hanson, J. R. 1992. The microbiological Transformation of diterpenoids. Nat. Prod. Rep. 12: 207-218.

26. Takahashi, J. A., Boaventura, M. A. D., Bayma, J. C., Oliveira, A. B. 1995. Frutoic acid, a dimeric kaurane diterpene from *Xylopia frutescens.* Phytochemistry 40: 607-609.

27. Vieira, H. S., Takahashi, J. A., Boaventura, M. A. D. 2001. Constituents of aerial parts of *Wedelia paludosa.* Fitoterapia 72: 854-856.

28. Mori, K., Matsui, M. 1966. Total synthesis of (-)-Kaur-16-en-19-oic acid. Tetrahedron Let. 2: 175-180.

29. Padmaja, V., Thankamany, V., Hara, N., Fujimoto, Y., Hisham, A. 1995. Biological activity of *Annona glabra.* J. Ethnophamaculogy. 48: 21-24.

30. Alves, T. M. A., Chaves, P. P. G., Santos L. M. S. T., Nagem, T. J., Murta, A. M. F., Deravolo, I. P., Romanha, A. J., Zani, C. 1995. A diterpene from *Mikania obtusata* active on *Trypanosoma cruzi.* Planta. Med. 61: 85-87.

31. Costa, F. B., Albuquerque, S., Vidhnewski, W. 1966. Diterpenoid and synthesis derivative from *Viguiera aspillioides* with Trypanomicidal activity. Planta. Med. 62: 557-559.

32. Wu, Y. C., Hung, Y. C., Chang, F. R., Consentino, M., Wang, H. K. 1996. Identification of 16β,17-dihydroxy-ent-kauran-19-oic acid as anti- HIV principle and isolation of new diterpeniods annosquamosin A and B from *Annona squamosa.* J Nat. Prod. 59: 635-637.

33. Chang, F. R., Yang, P. Y., Lin, J. Y., Lee, K. H., Wu, Y. C. 1998. Bioactive kaurane diterpenoids from *Annona glabra.* J. Nat. Prod. 59: 437-439.

34. Gerlach, E. H., Jones, R. N., and Barry, A. L. 1983. Collaborative evaluation of the microbial profile system for quantitative antimicrobial susceptibility testing. J. Clin. Microbiol. 17: 436-444.

35. Gaskin, P., Hutchison, M., Lewis, N., Macmillan, J., Phinney, B. O. 1997. Microbiological conversion of 12-oxygenated and other derivatives of *ent*-kaur-16-en-19-oic acid by *Gibberella Fujikuroi*, Mutant B1-41a. Phytochemistry 23: 559-564.

36. Bearder, J. R., Macmillan, J., Wels, C. M. 1975. The metabolism of steviol to 13-hygroxylated *ent*-gibberellanes and *ent*-kauranes. Phytochemistry 14: 1741-1748.

APPENDICES

ต้นฉบับ หน้าขาดหาย

ต้นฉบับ หน้าขาดหาย

ต้นฉบับ หน้าขาดหาย

APPENDIX B

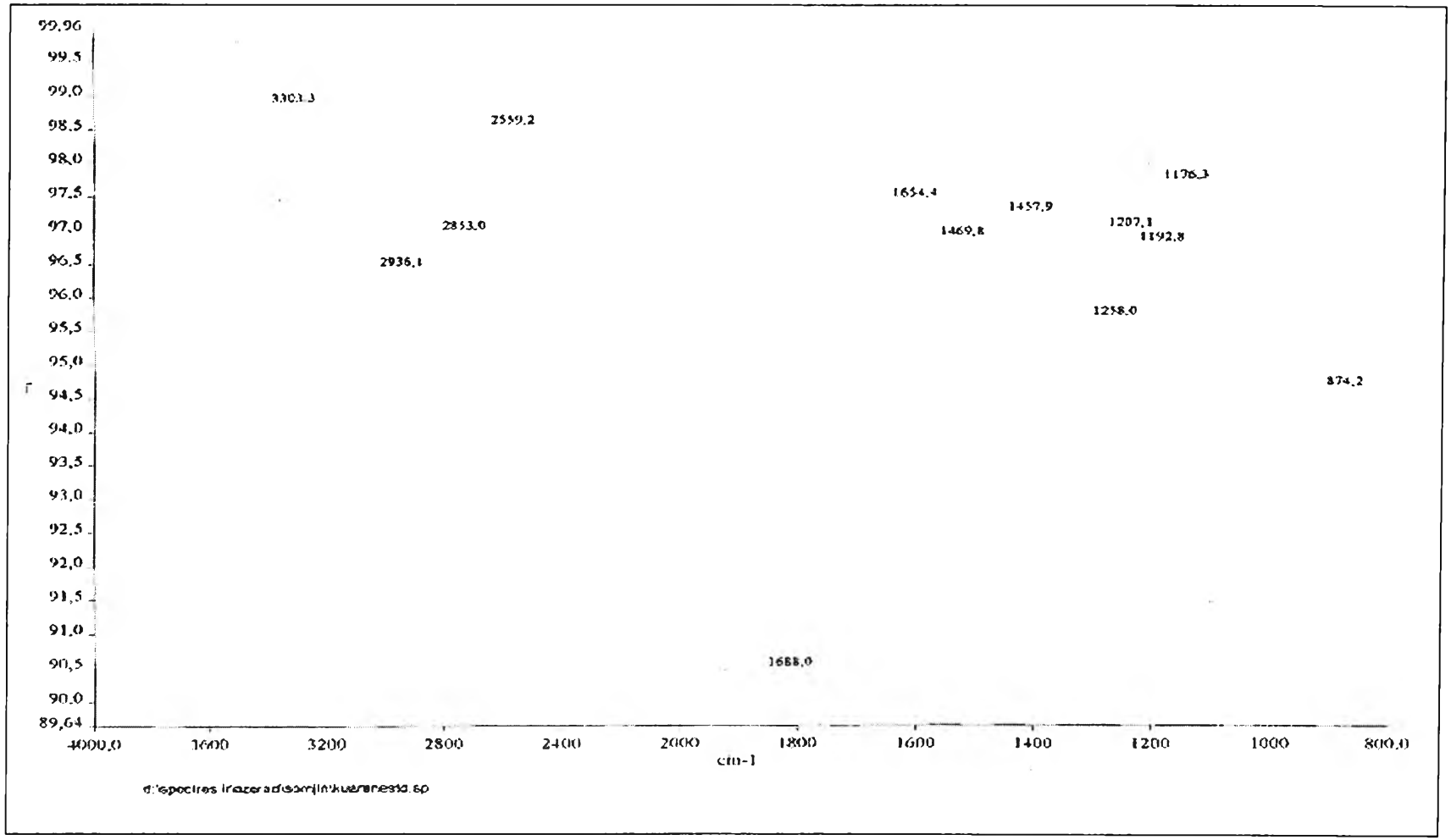

Figure B1. The IR spectrum of Compound 1.

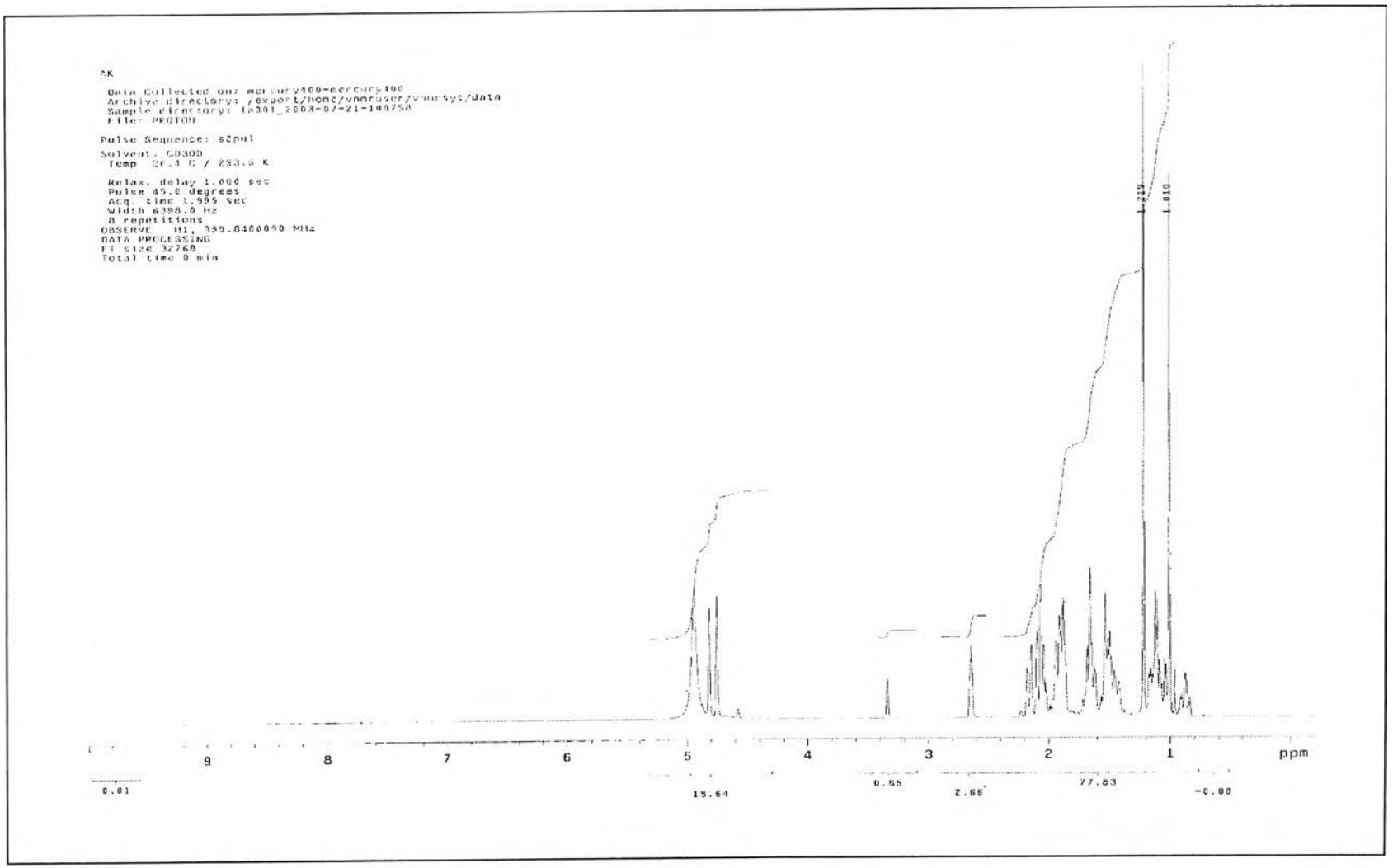

Figure B2. The ^{1}H-NMR spectrum of Compound **1**.

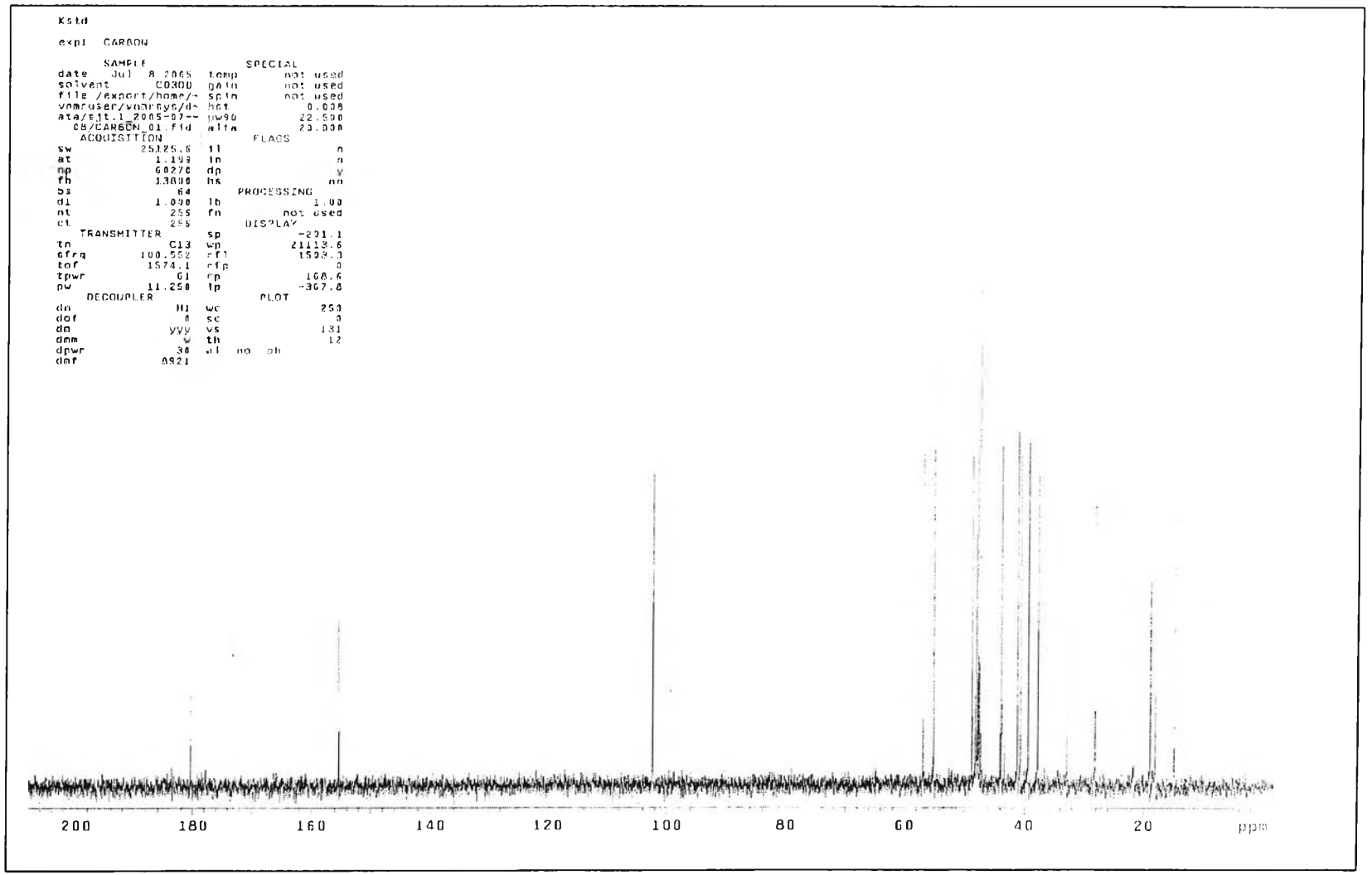

Figure B3. The ^{13}C-NMR spectrum of Compound **1**.

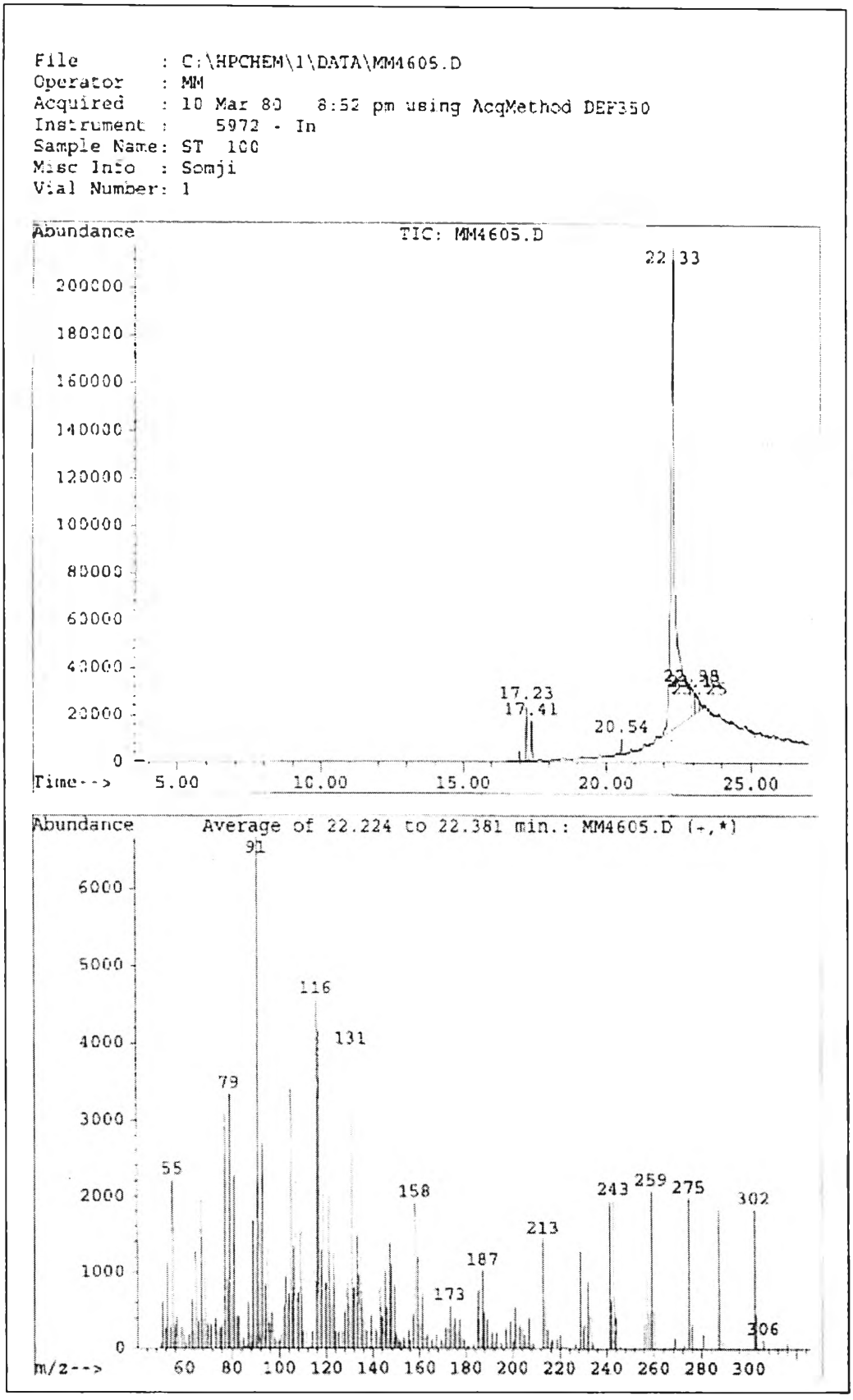

Figure B4. The GC- MS spectrum of Compound 1.

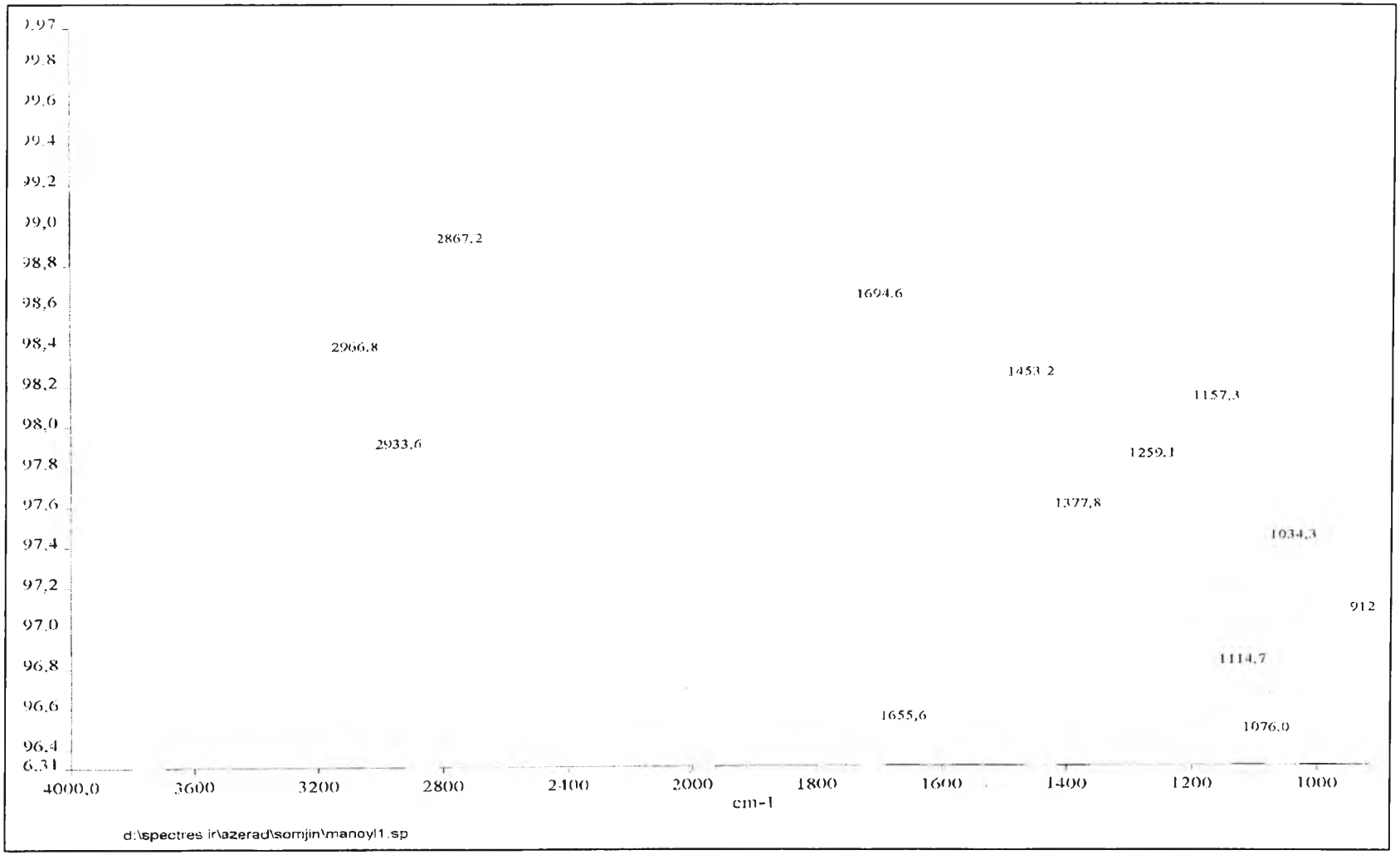

Figure B5. The IR spectrum of Compound **2**.

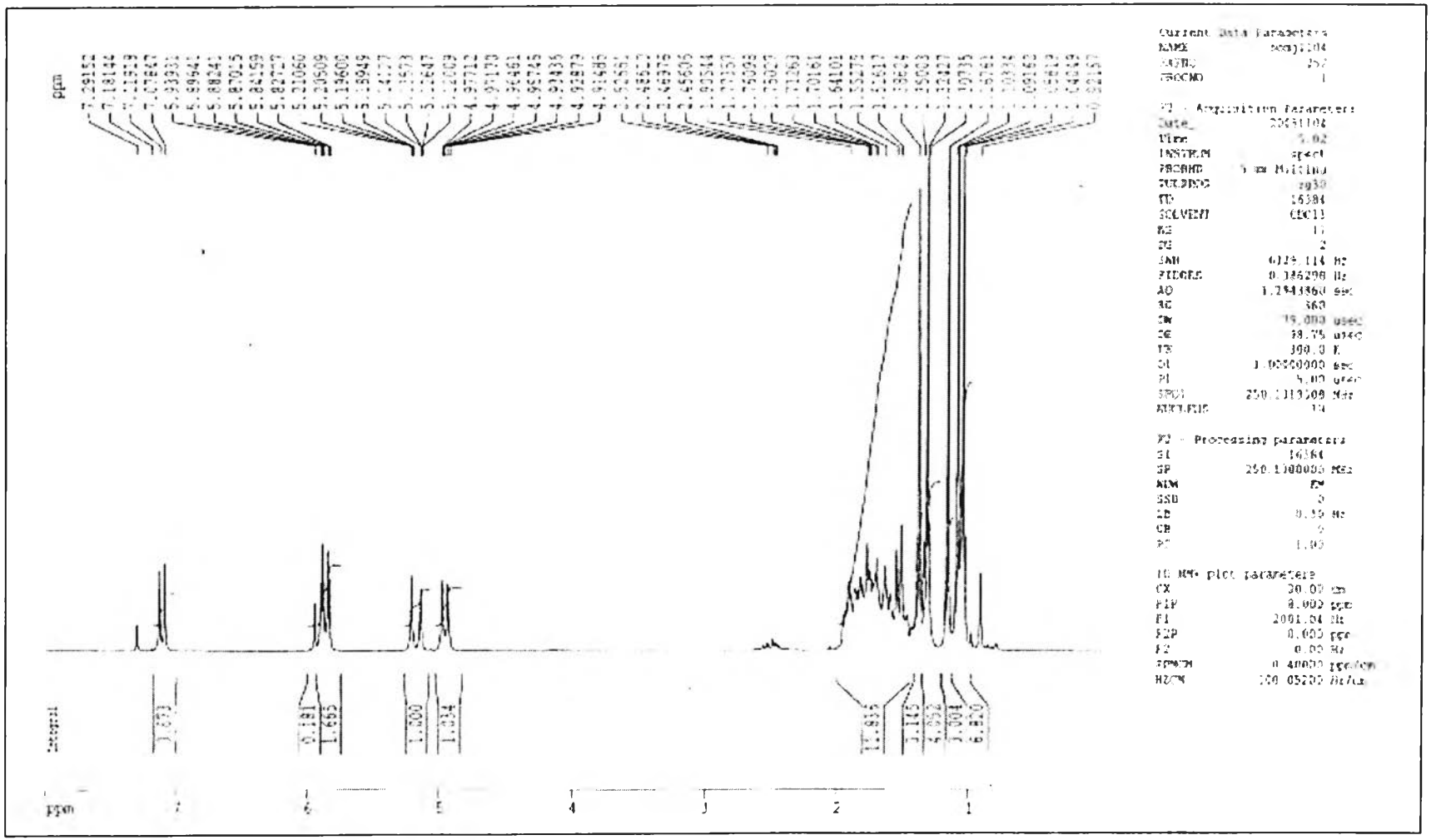

Figure B6. The ^{1}H-NMR spectrum of Compound **2**

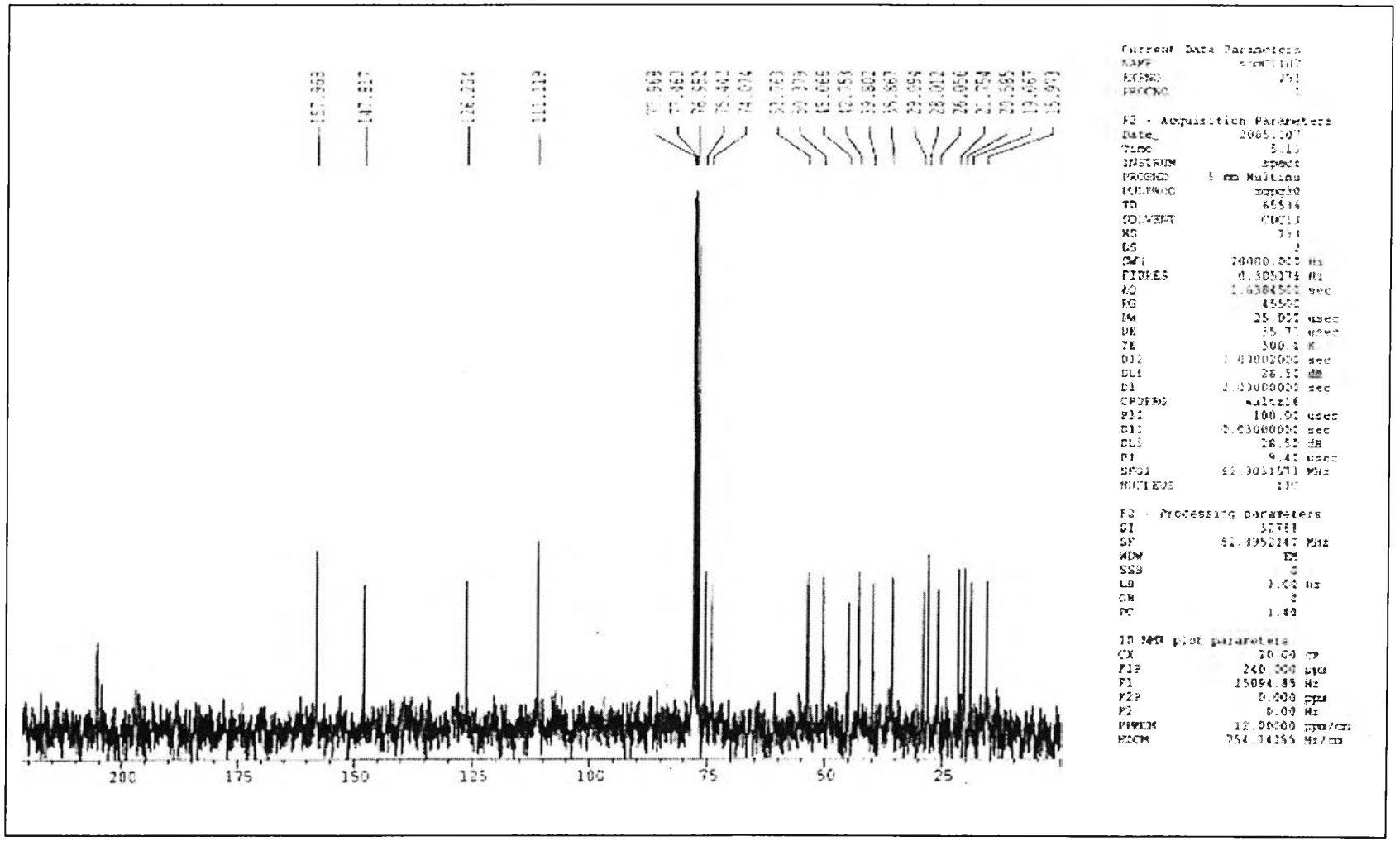

Figure B7. The ^{13}C-NMR spectrum of Compound **2**.

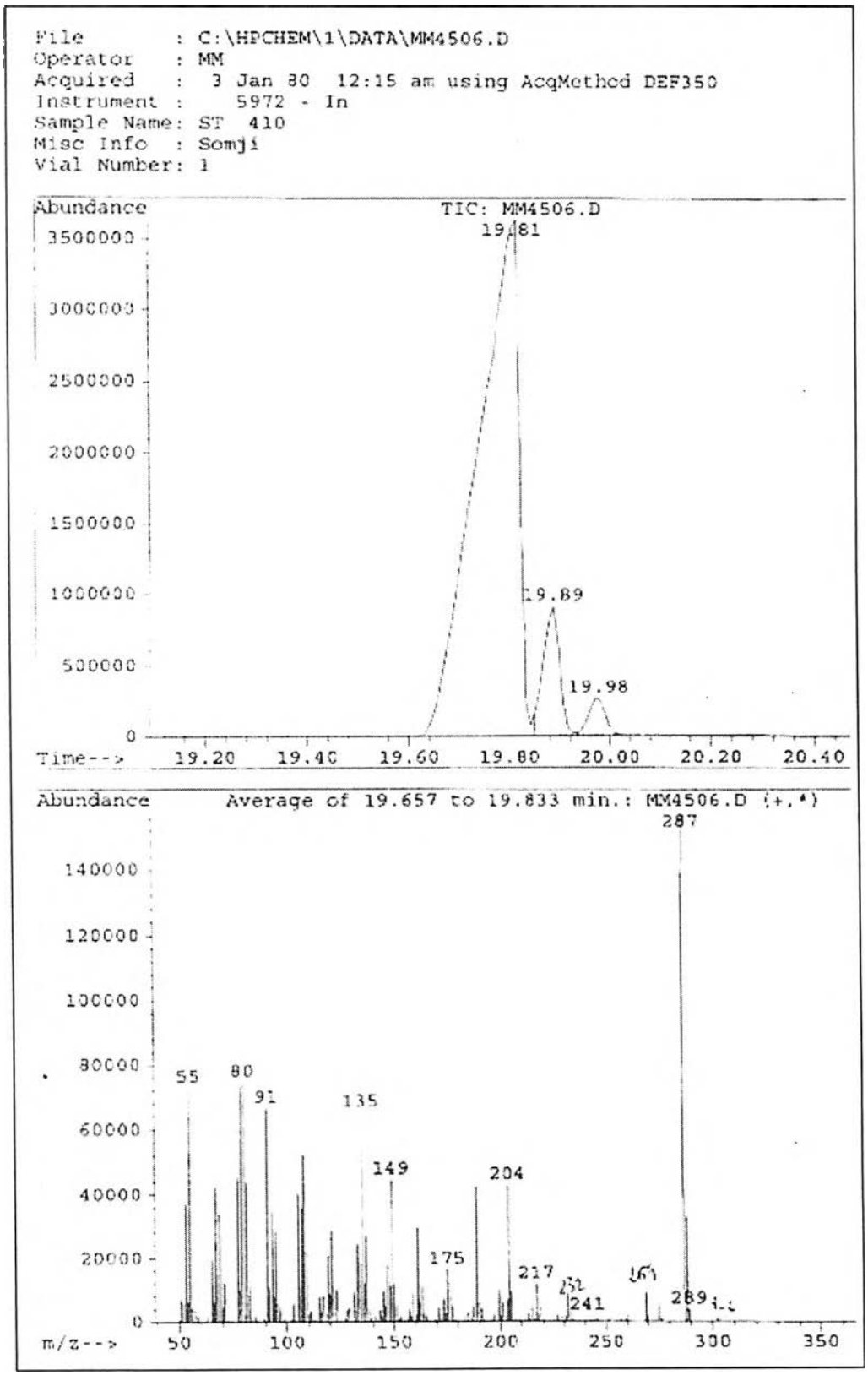

Figure B8. The GC- MS spectrum of Compound **2**.

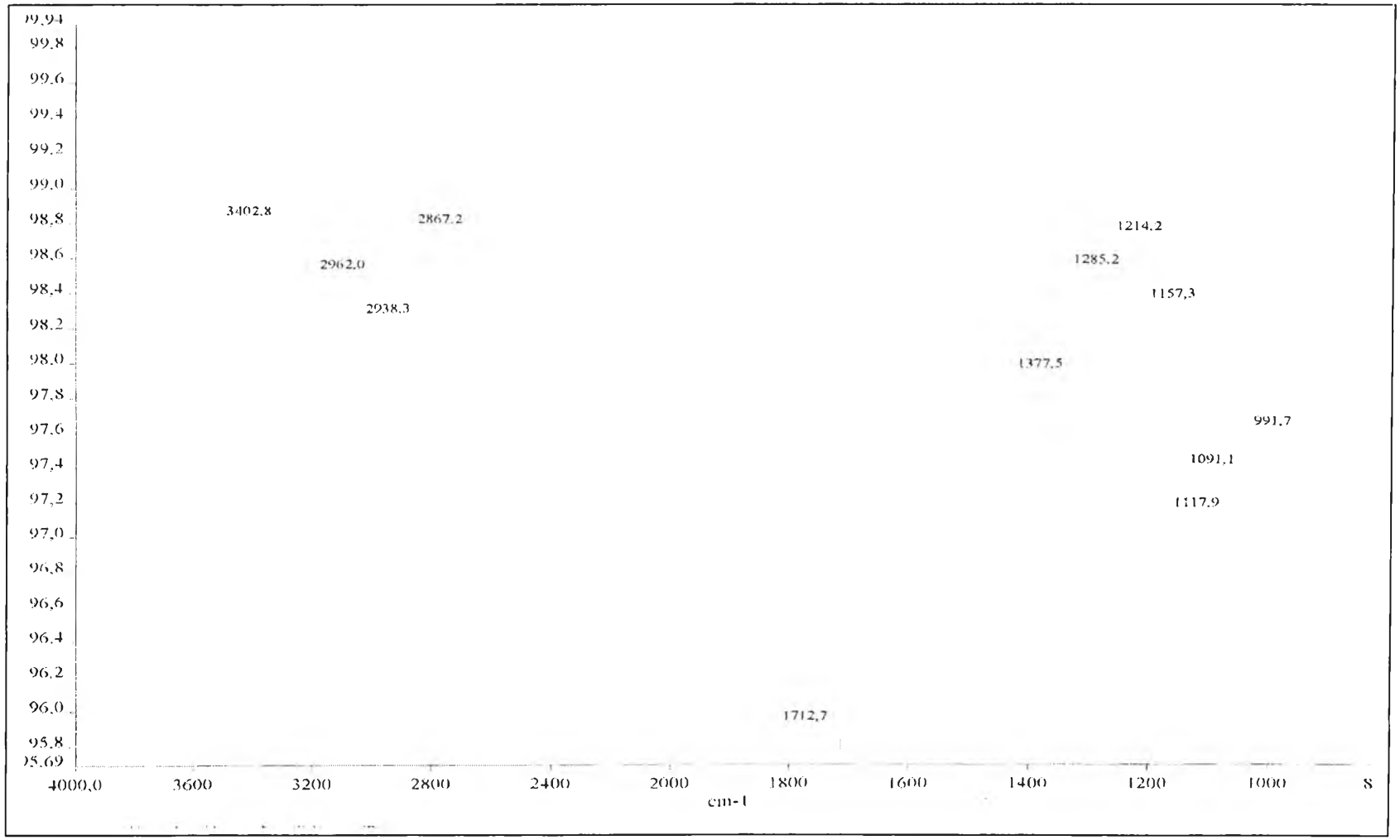

Figure B9. The IR spectrum of Compound **3**.

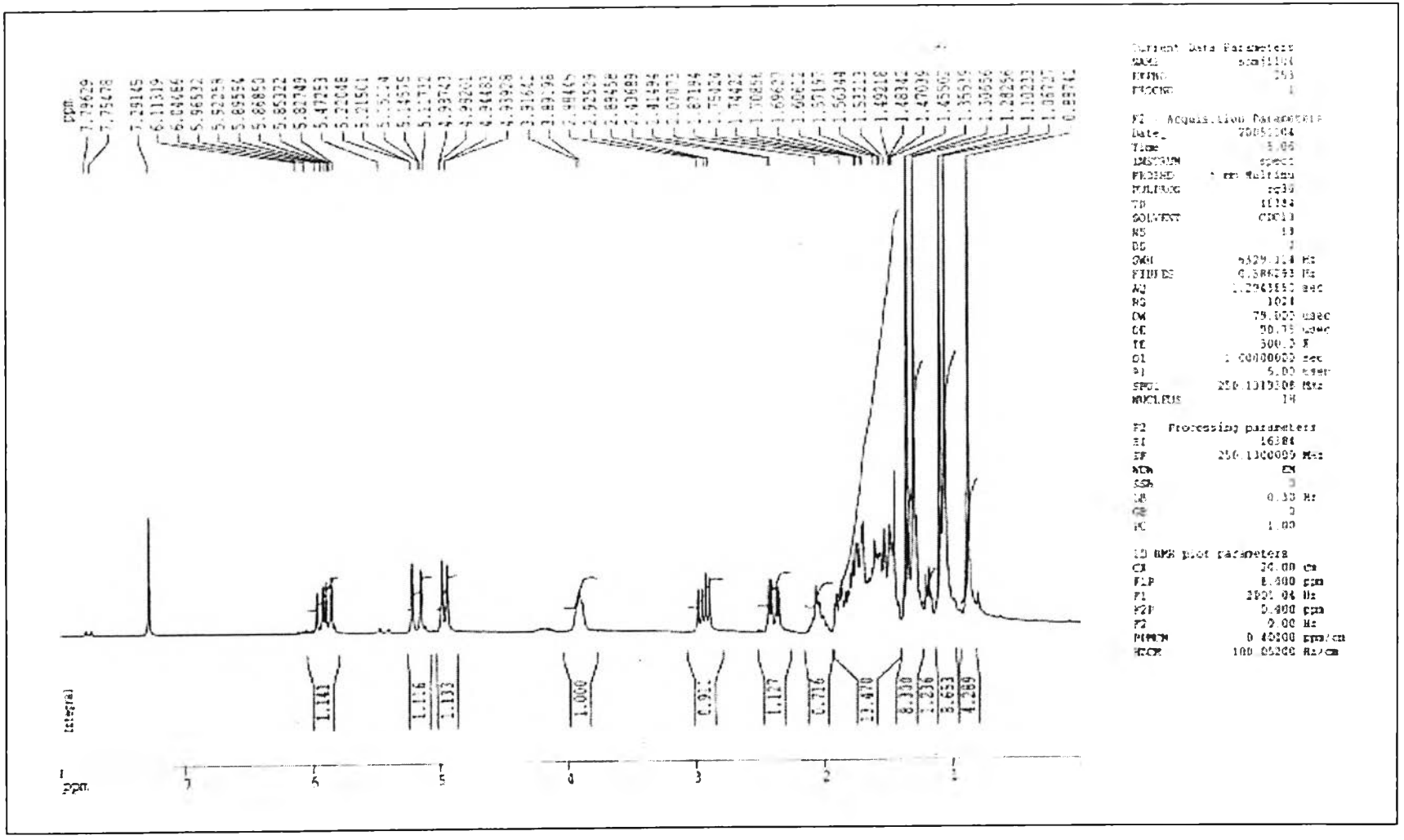

Figure B10. The ^{1}H-NMR spectrum of Compound **3**.

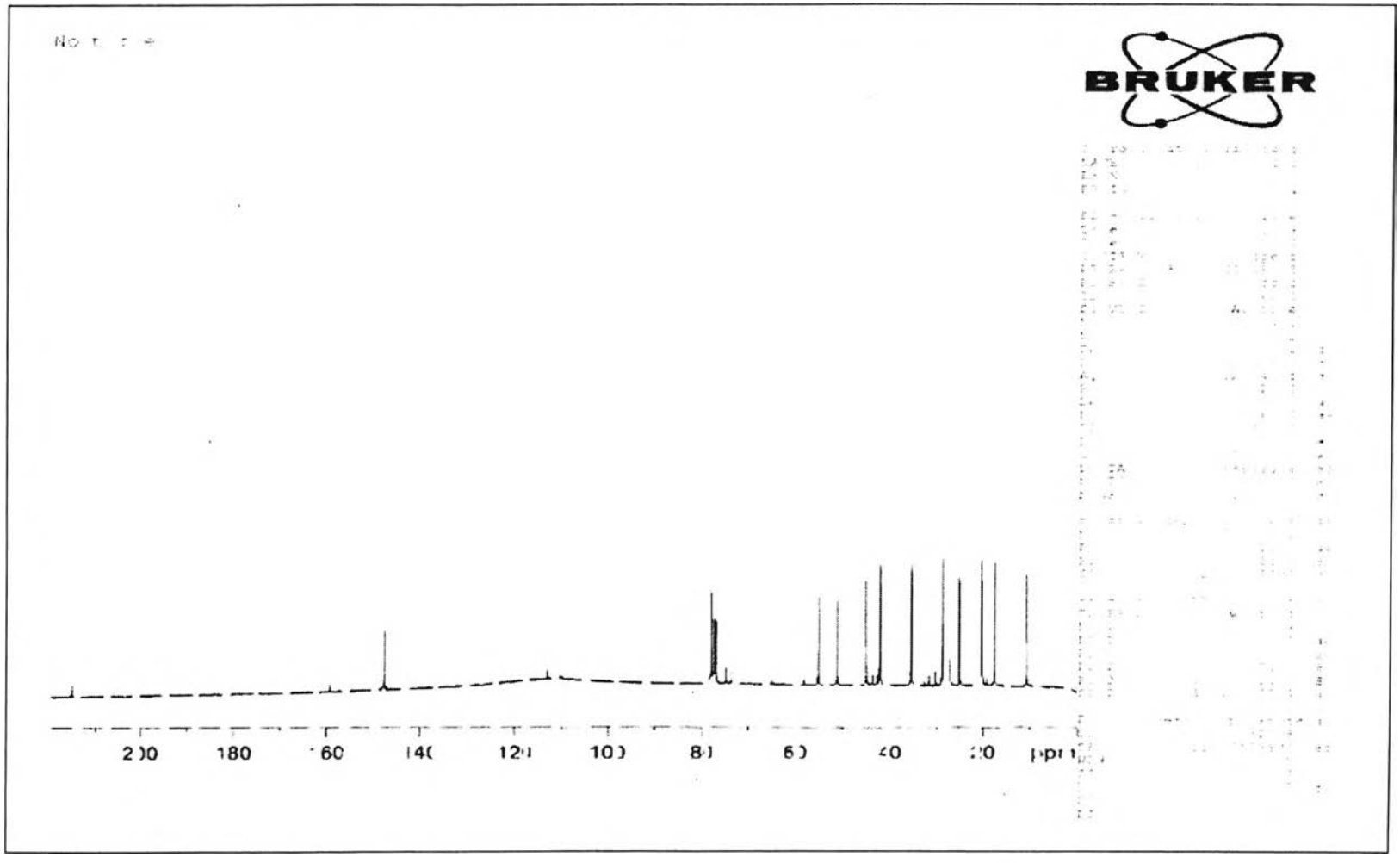

Figure B11. The ^{13}C-NMR spectrum of Compound **3**.

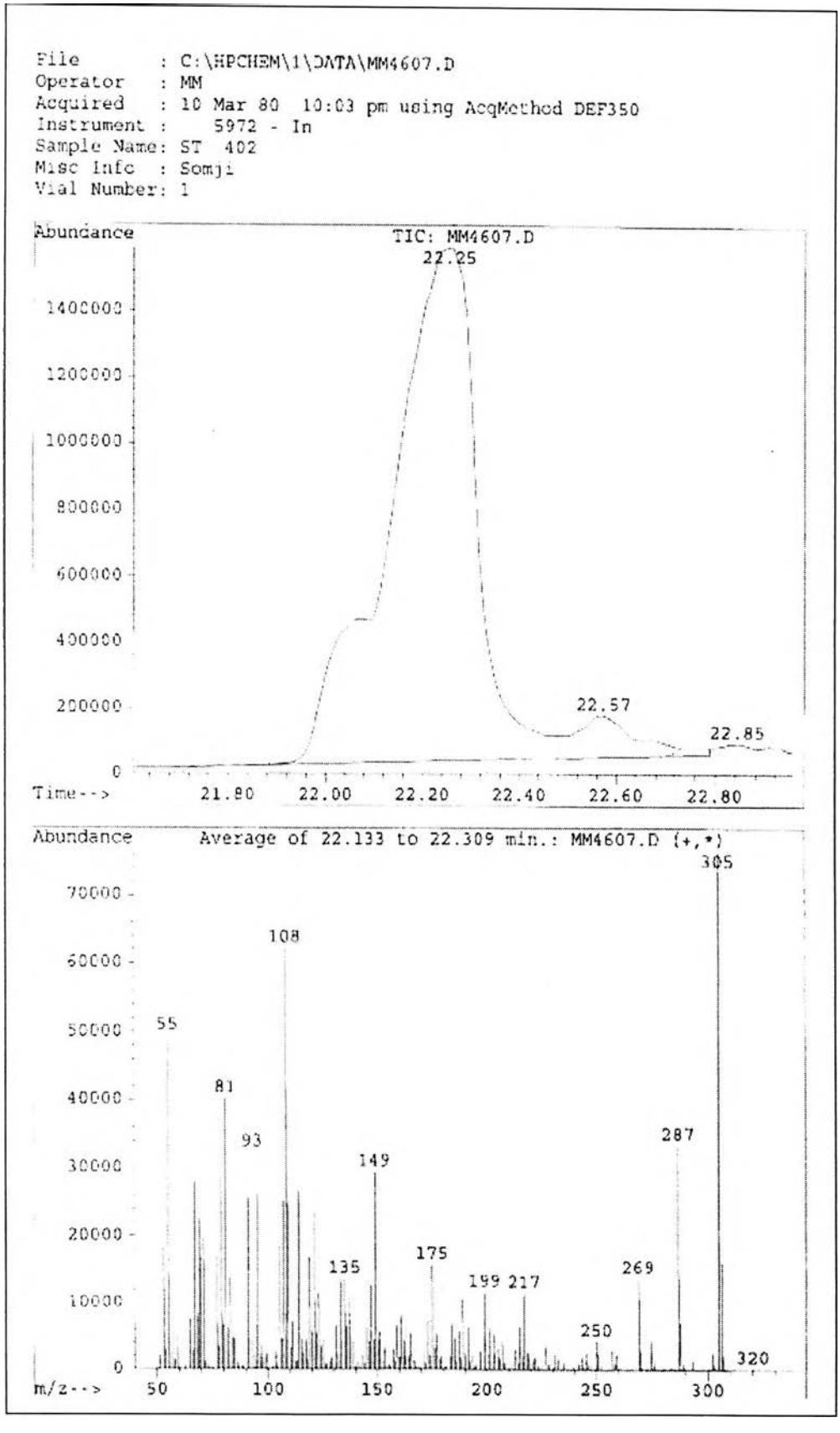

Figure B12. The GC- MS spectrum of Compound **3**.

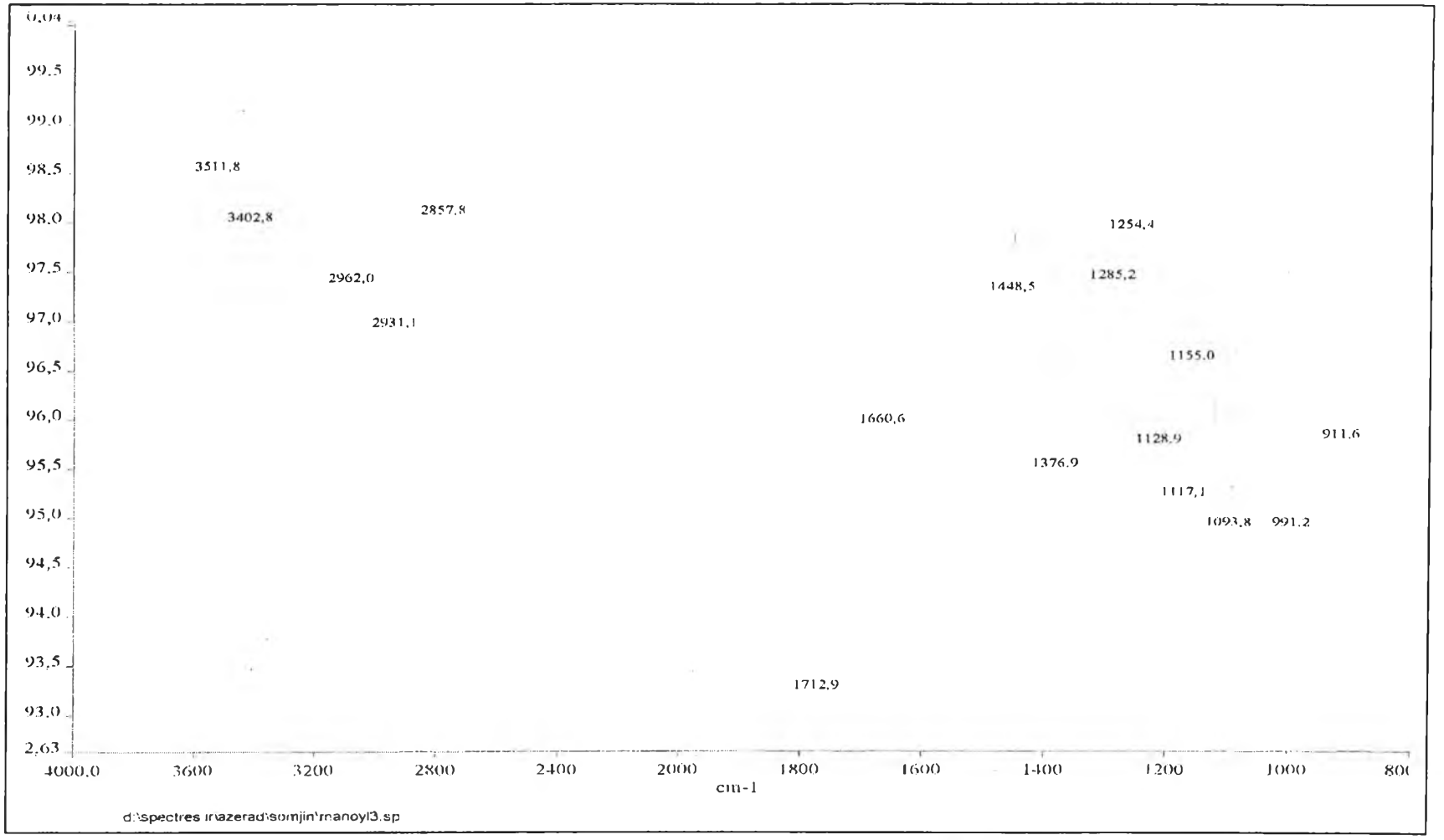

Figure B13. The IR spectrum of Compound **4**.

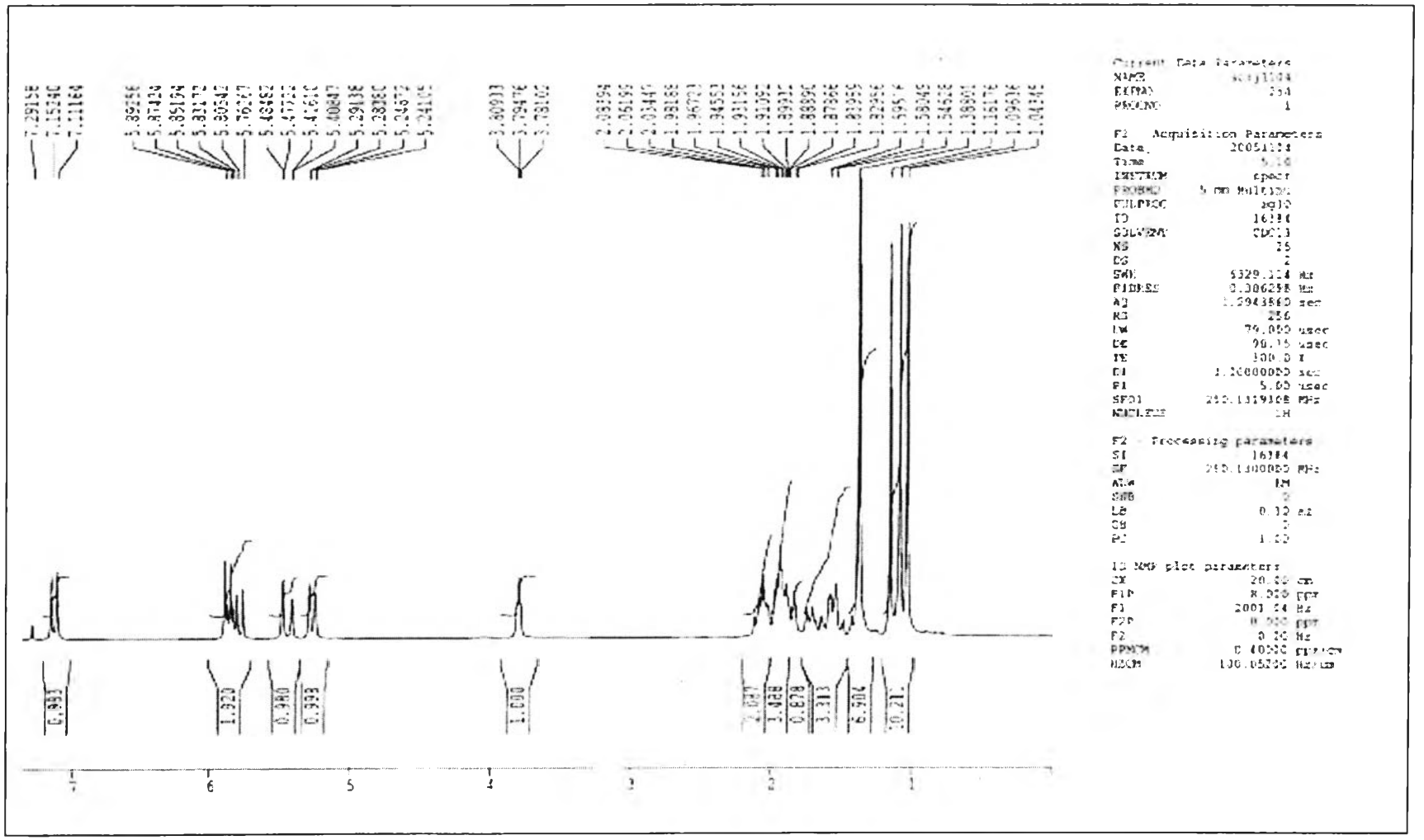

Figure B14. The ^{1}H-NMR spectrum of Compound **4**.

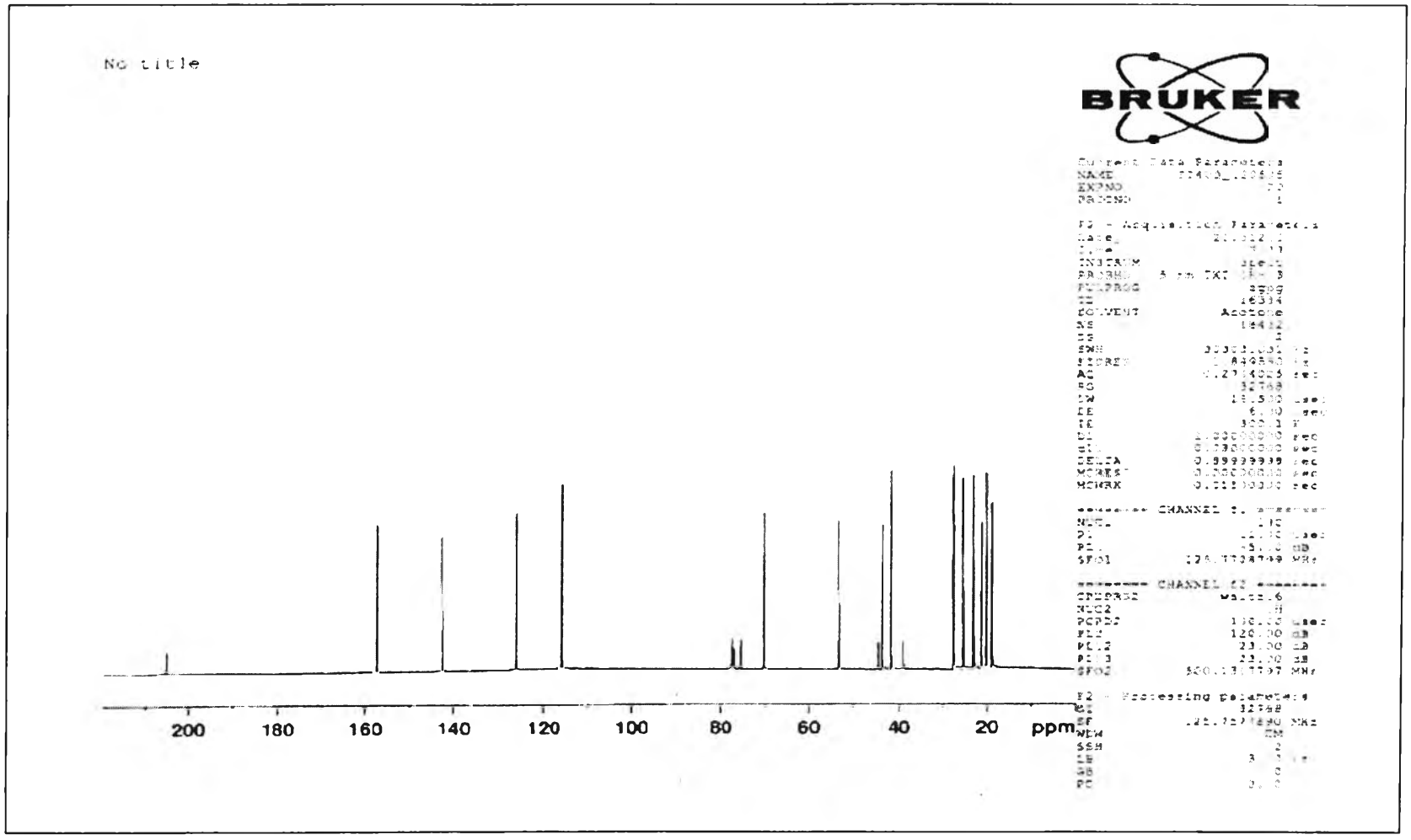

Figure B15. The ^{13}C-NMR spectrum of Compound **4**.

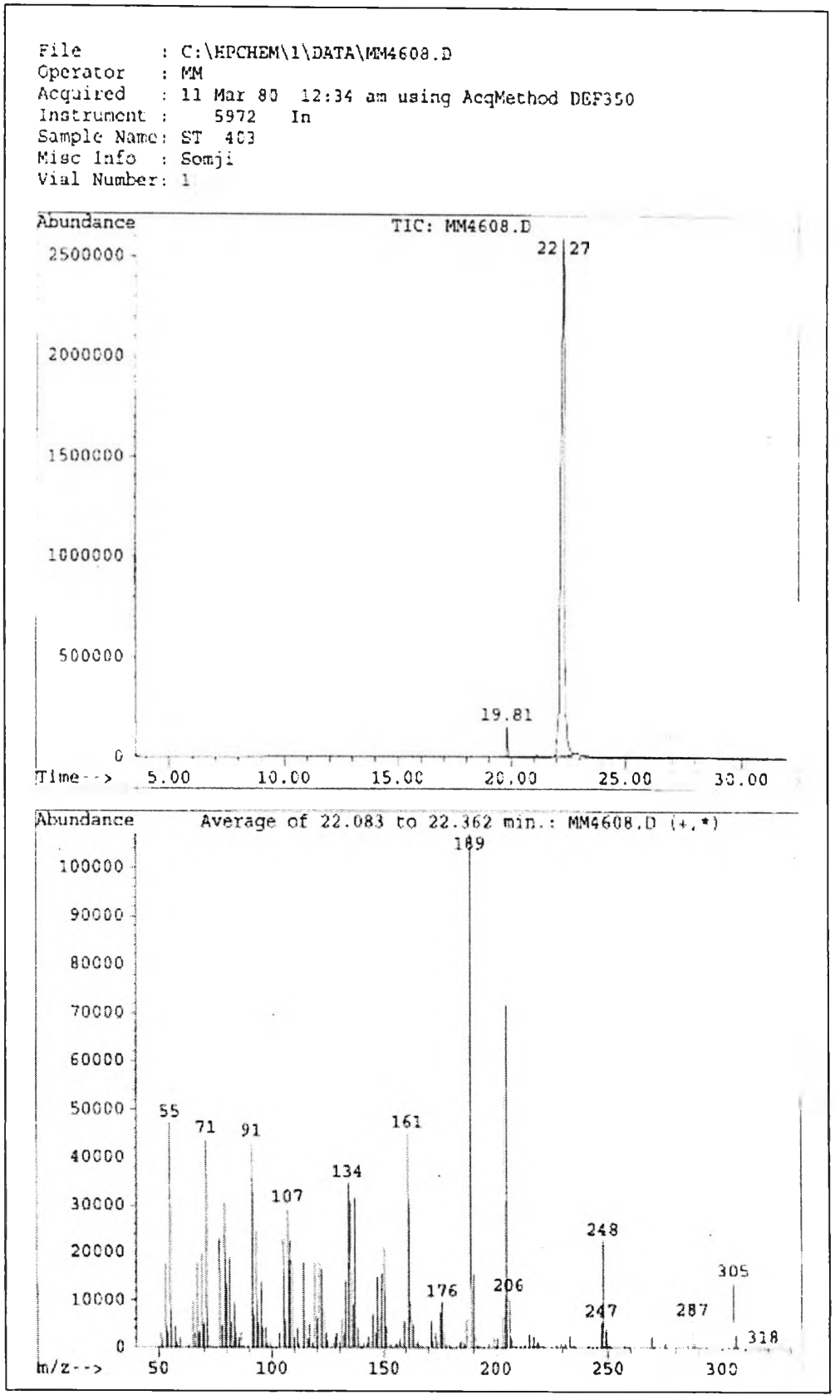

Figure B16. The GC- MS spectrum of Compound 4.

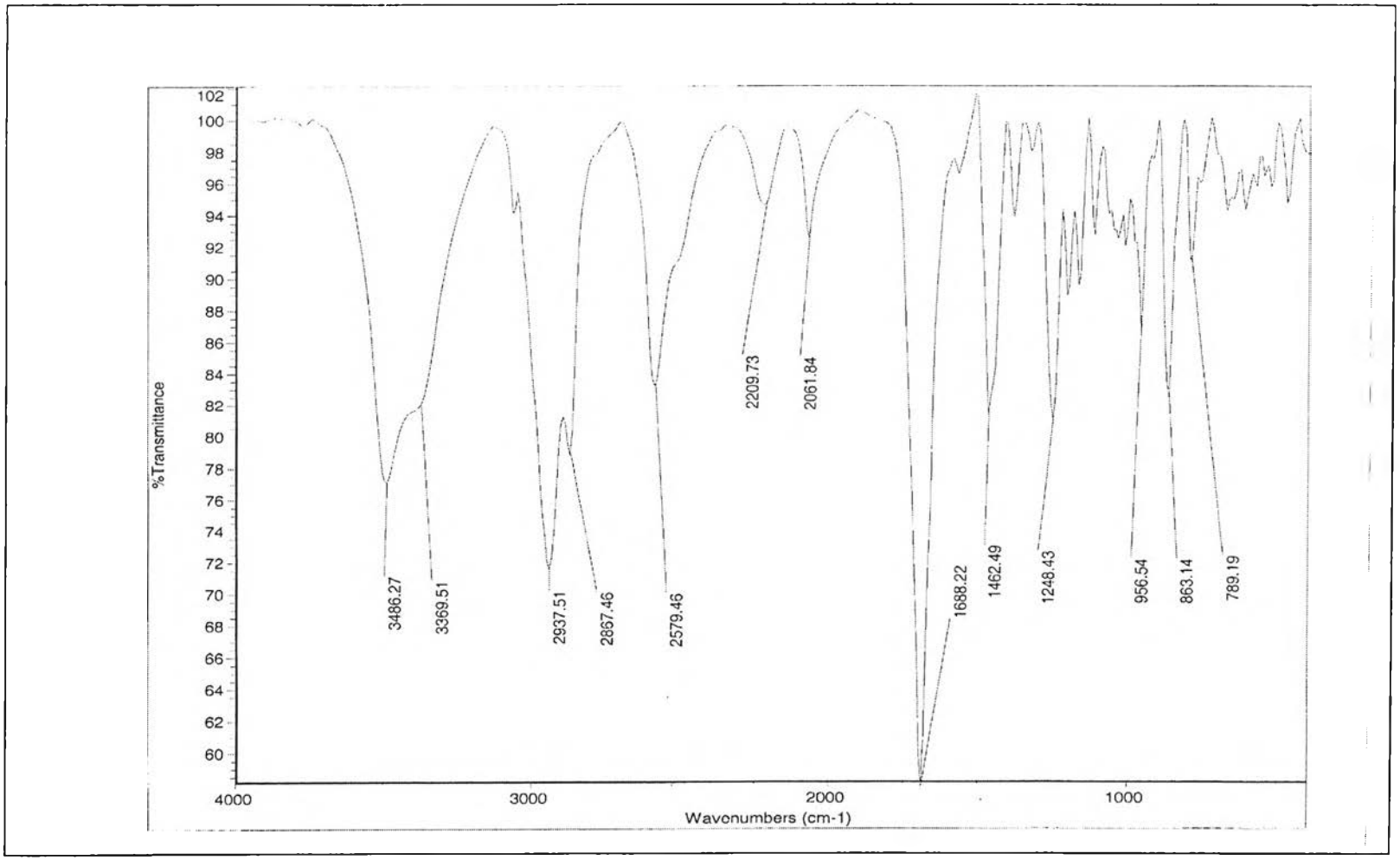

Figure B17. The IR spectrum of Metabolite **1a**.

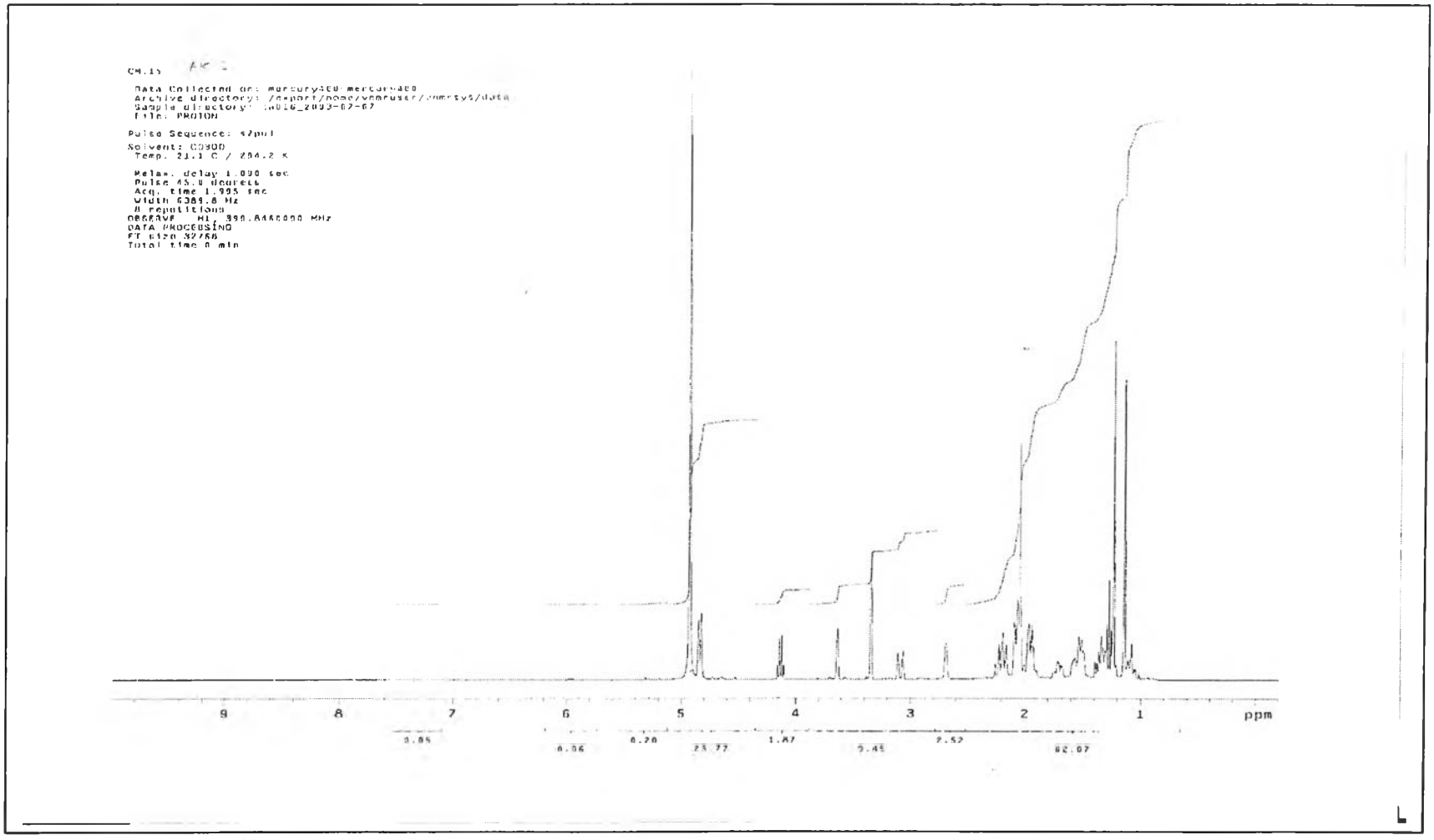

Figure B18. The ^{1}H-NMR spectrum of Metabolite **1a**.

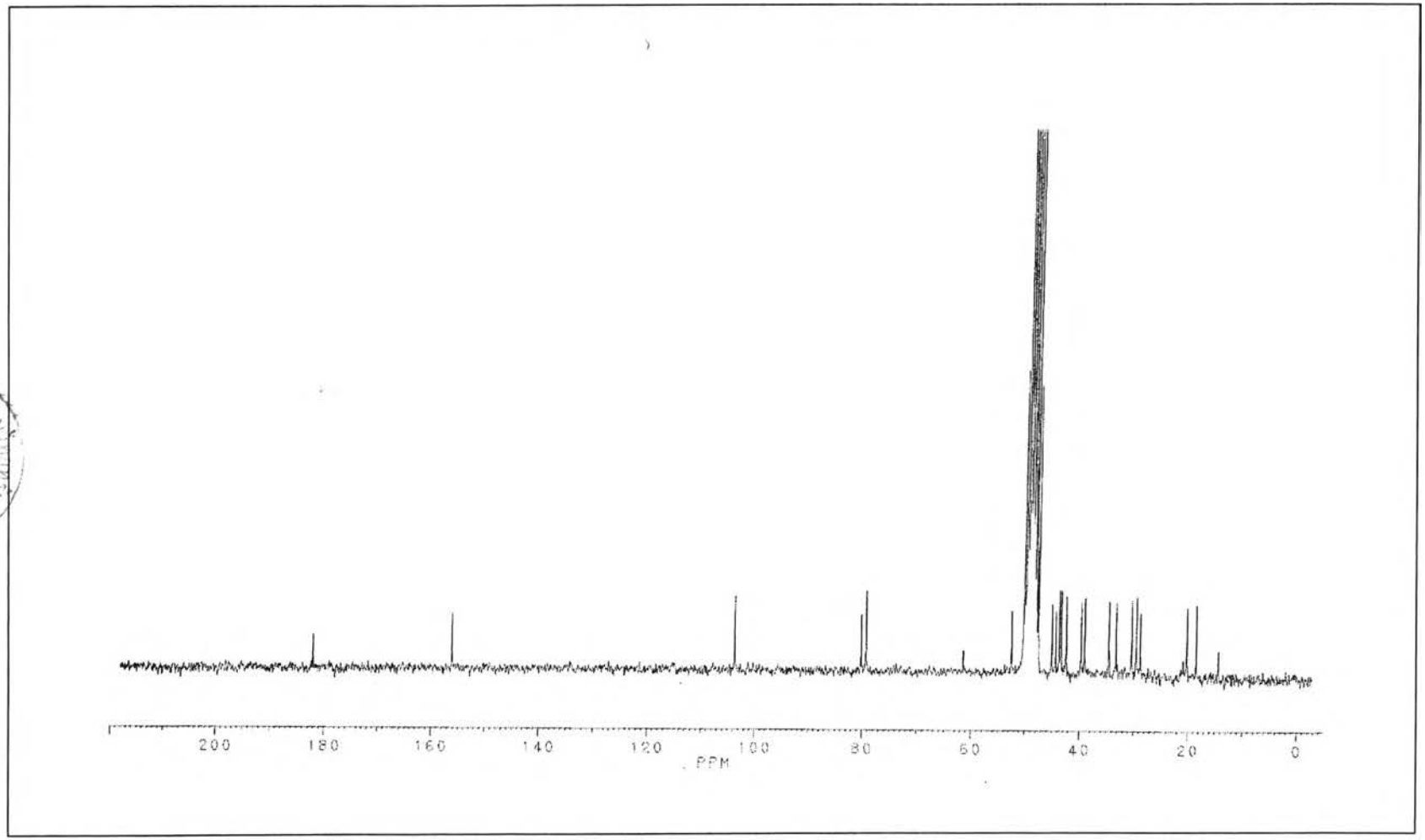

Figure B19. The ^{13}C-NMR spectrum of Metabolite **1a**.

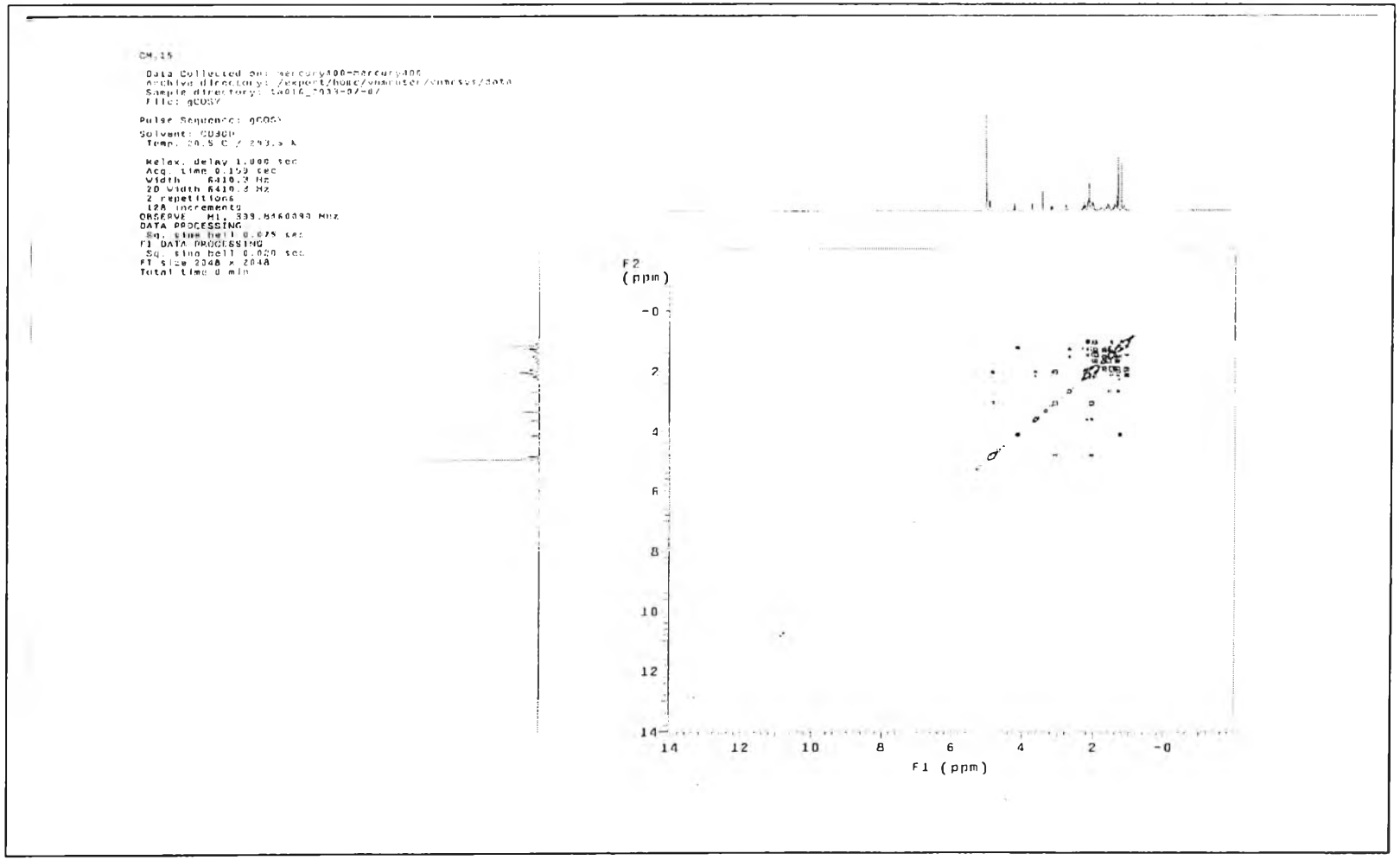

Figure B20. The gCOSY spectrum of Metabolite **1a**.

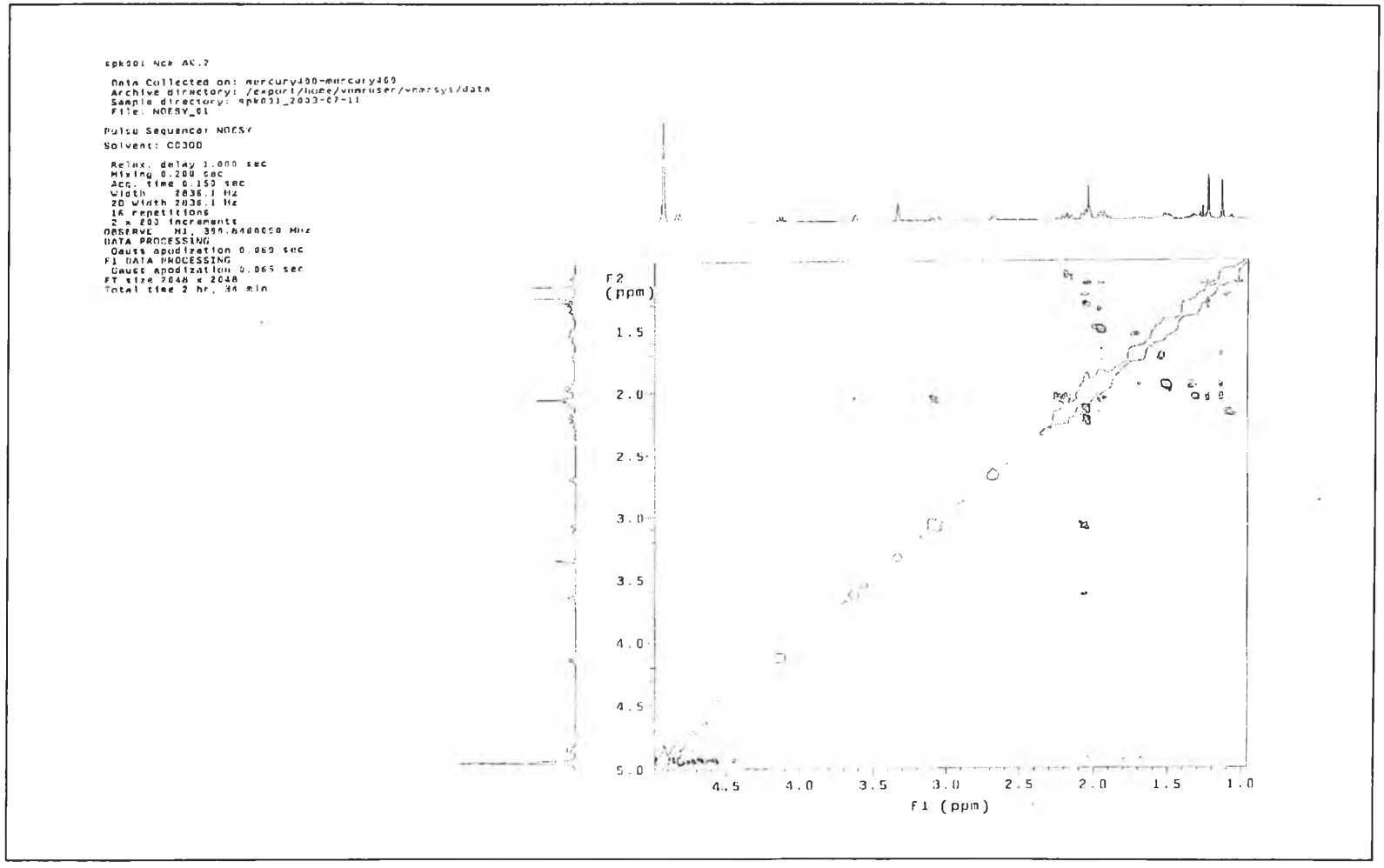

Figure B21. The gNOESY spectrum of Metabolite **1a**.

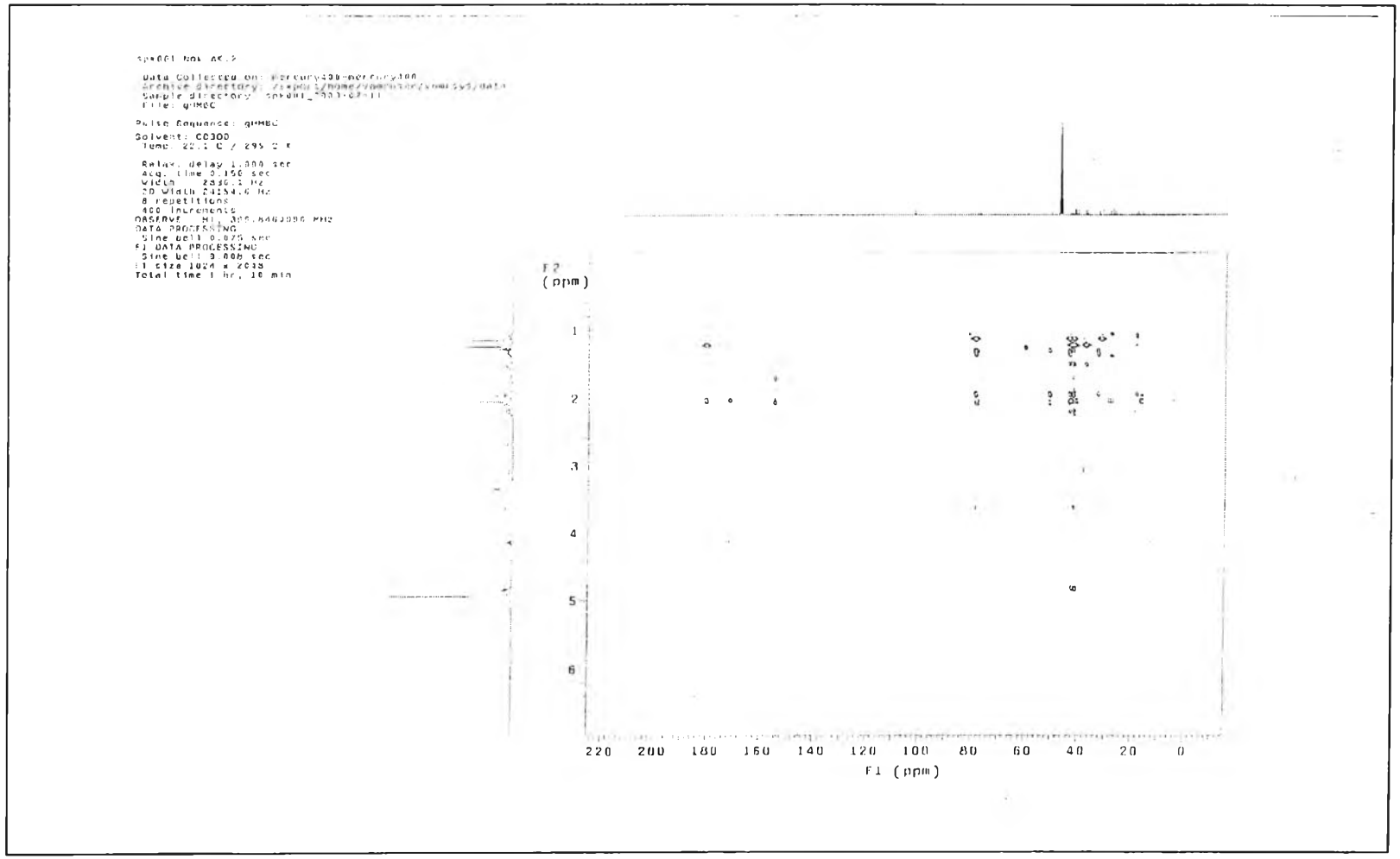

Figure B22. The gHMBC spectrum of Metabolite **1a**.

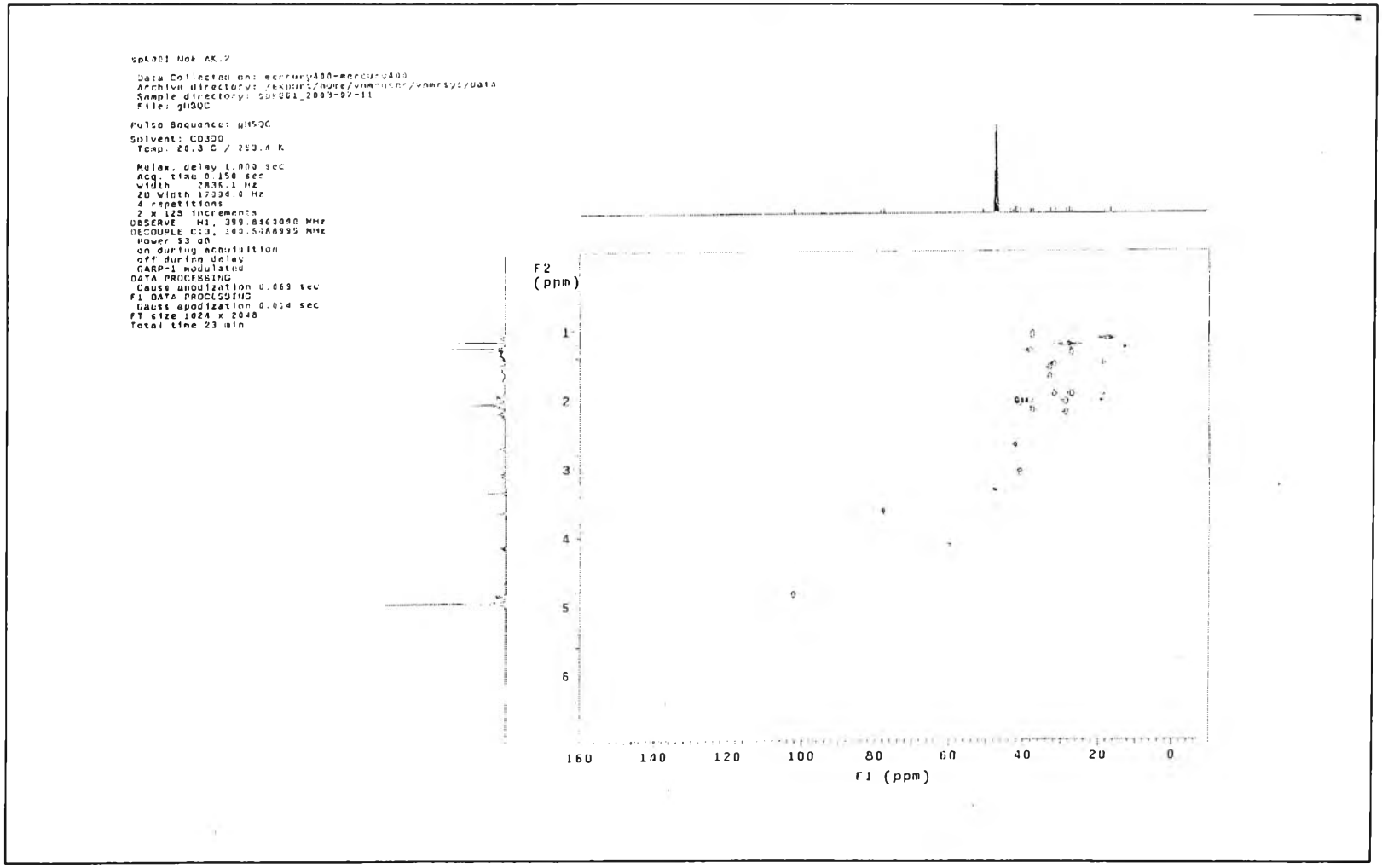

Figure B23. The gHSQC spectrum of Metabolite **1a**.

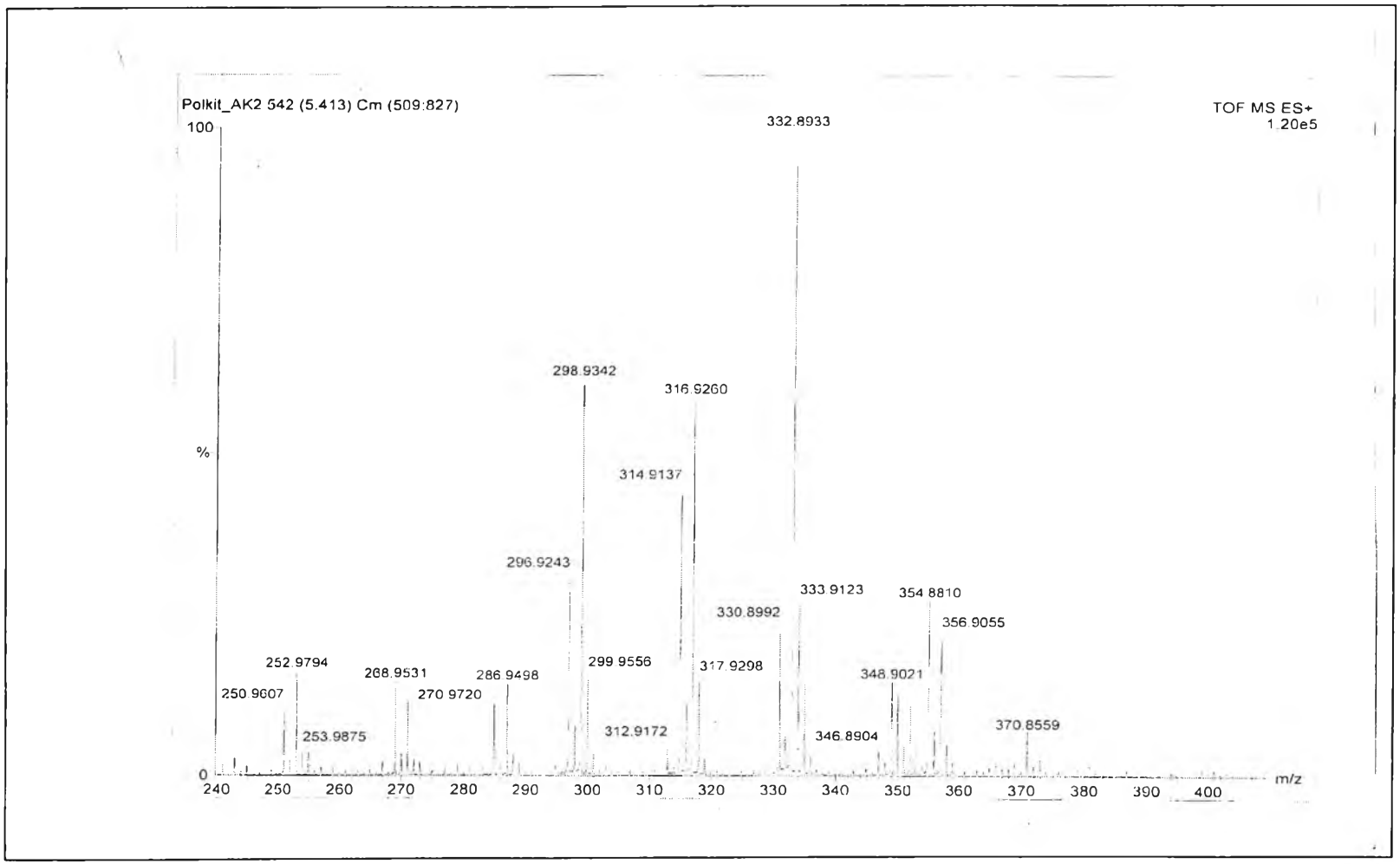

Figure B24. The LC-MS spectrum of Metabolite **1a**.

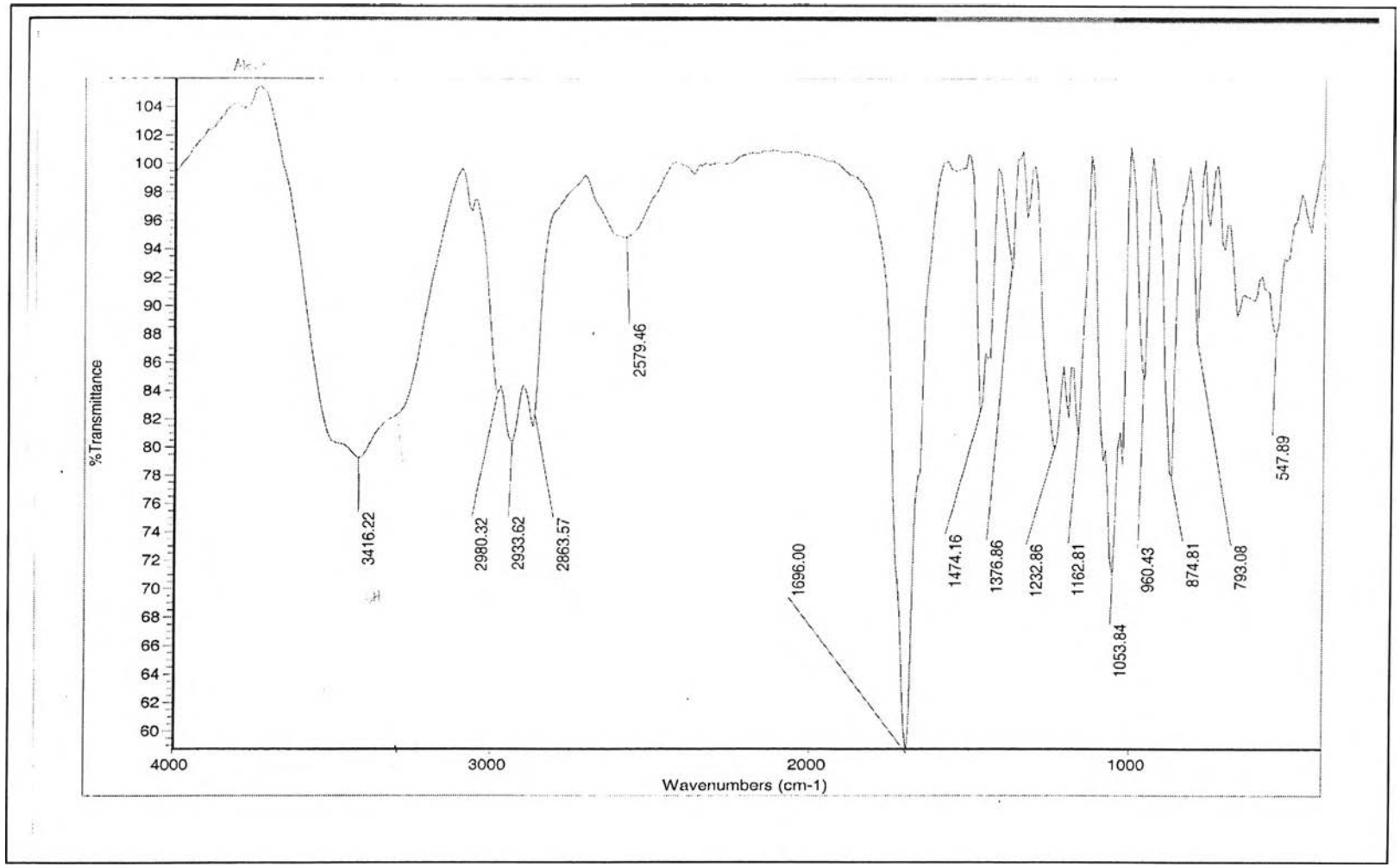

Figure B25. The IR spectrum of Metabolite **1b**.

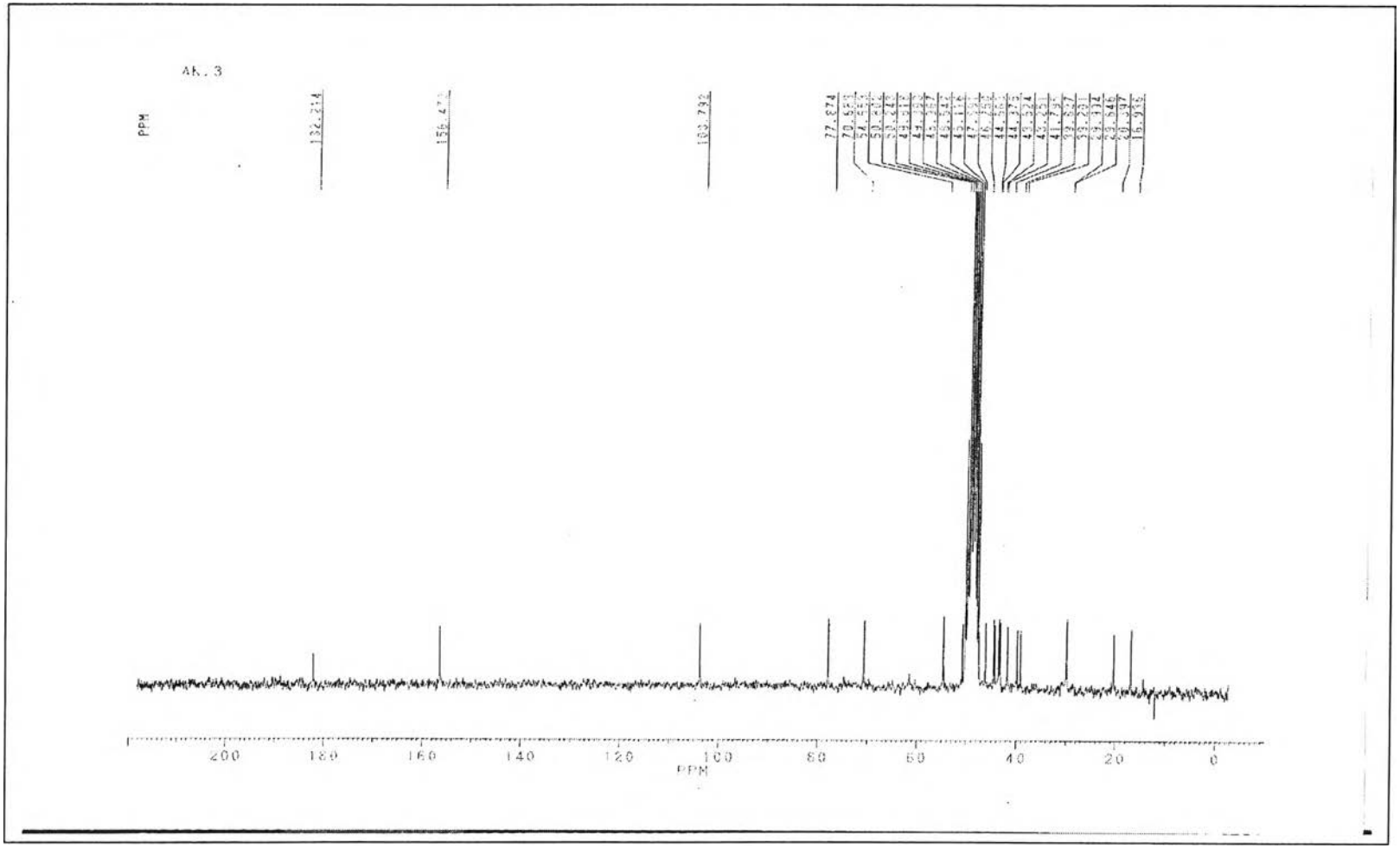

Figure B27. The ^{13}C-NMR spectrum of Metabolite **1b**.

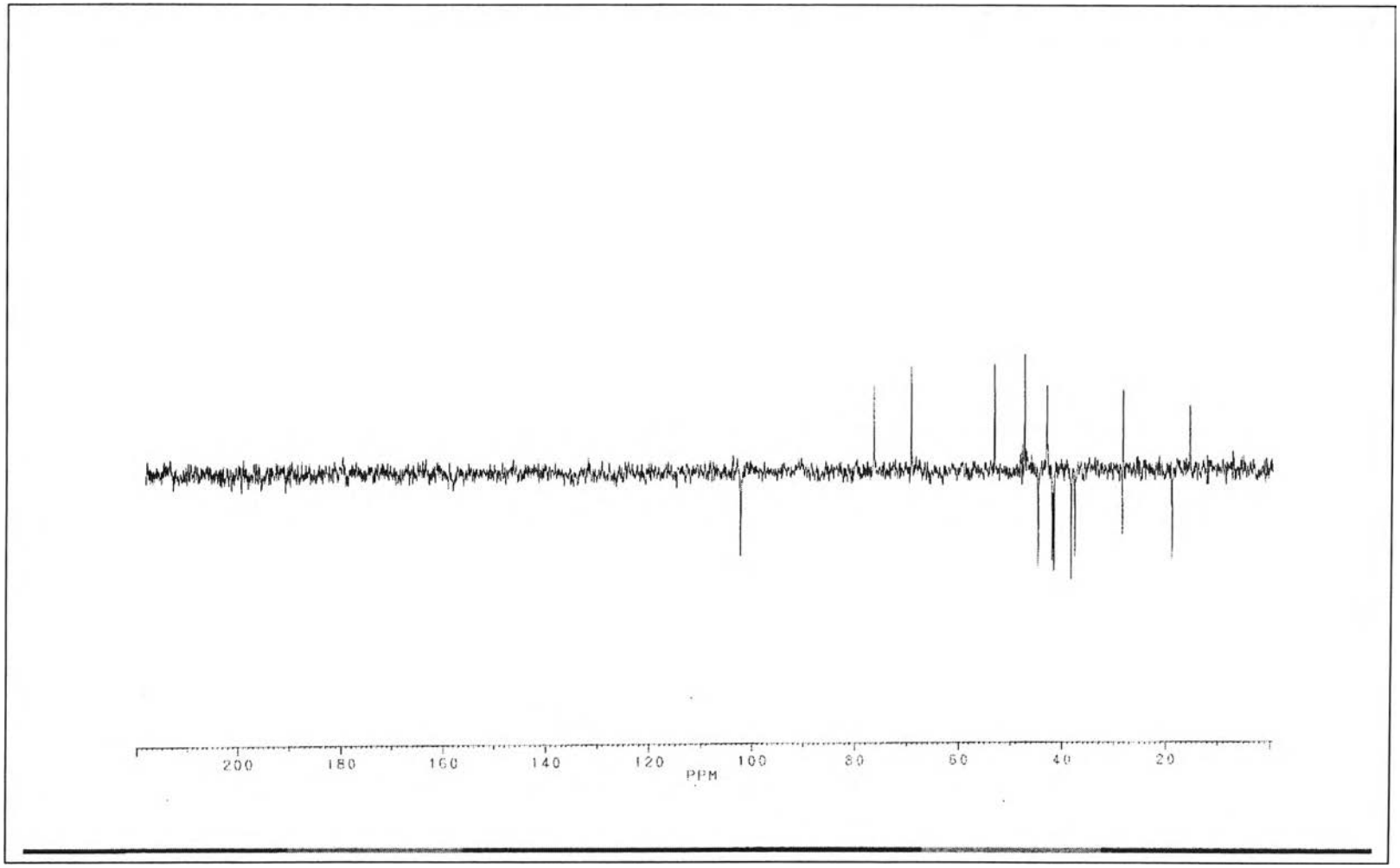

Figure B28. The DEPT spectrum of Metabolite **1b**.

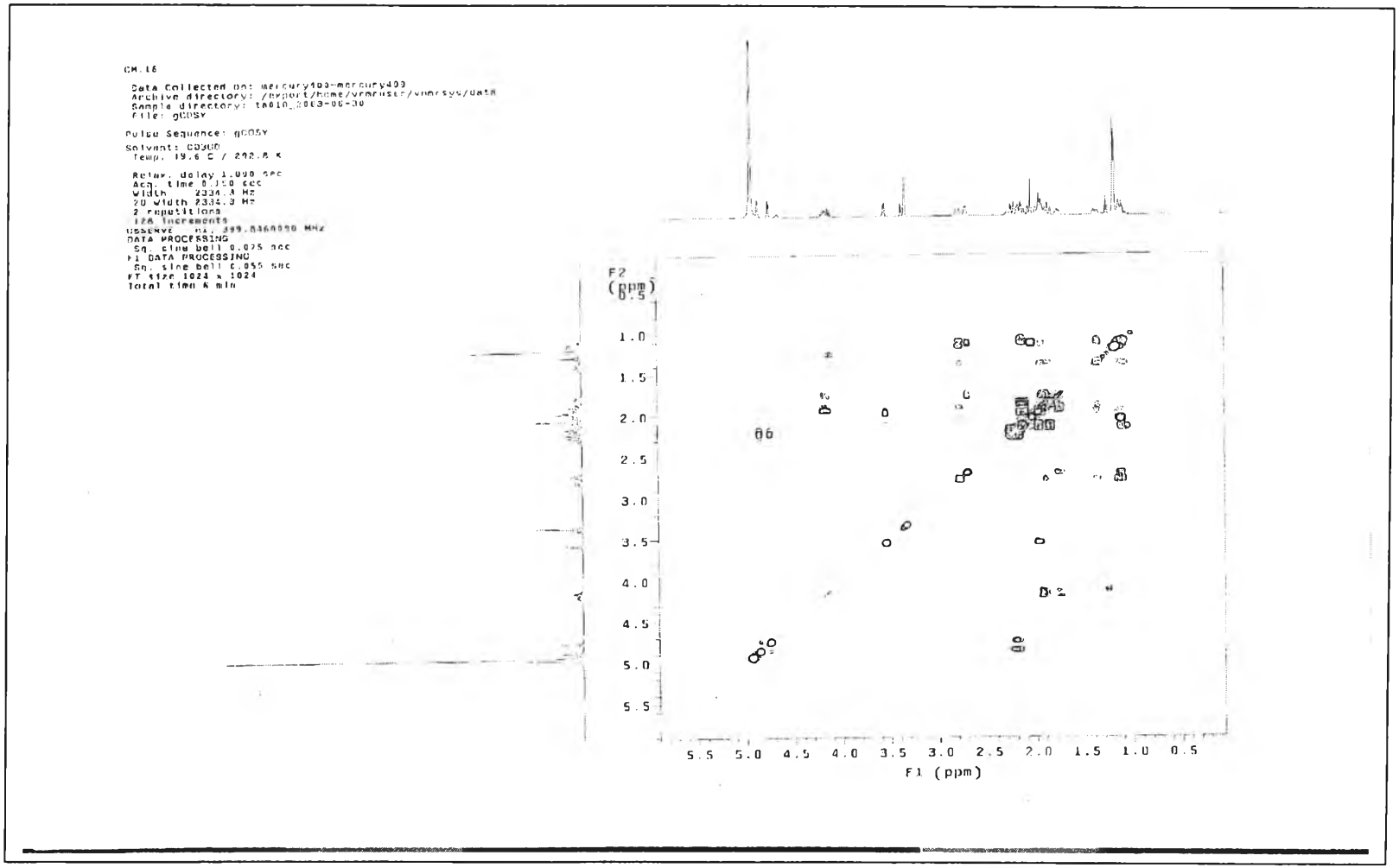

Figure B29. The gCOSY spectrum of Metabolite **1b**.

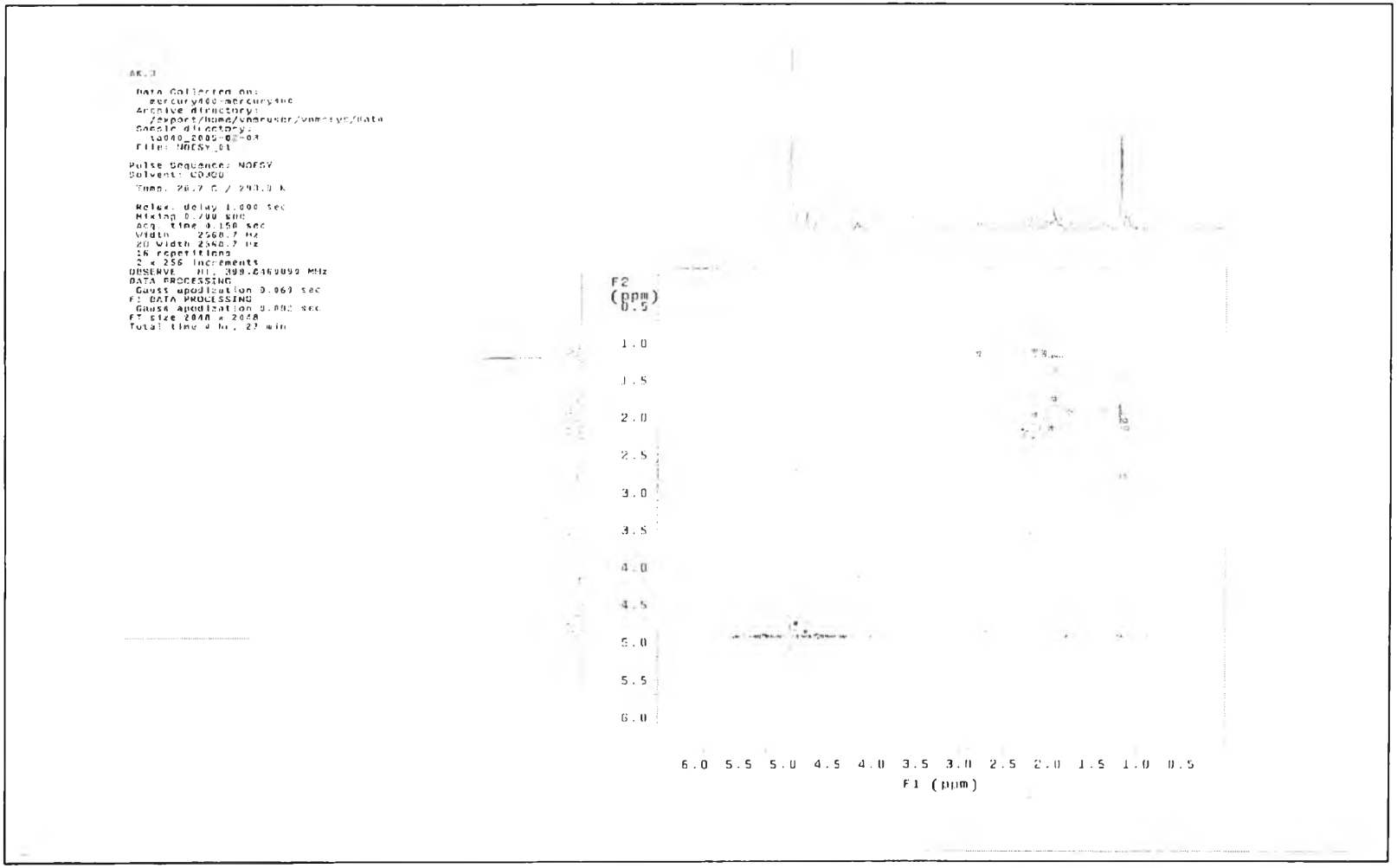

Figure B30. The gNOESY spectrum of Metabolite **1b**.

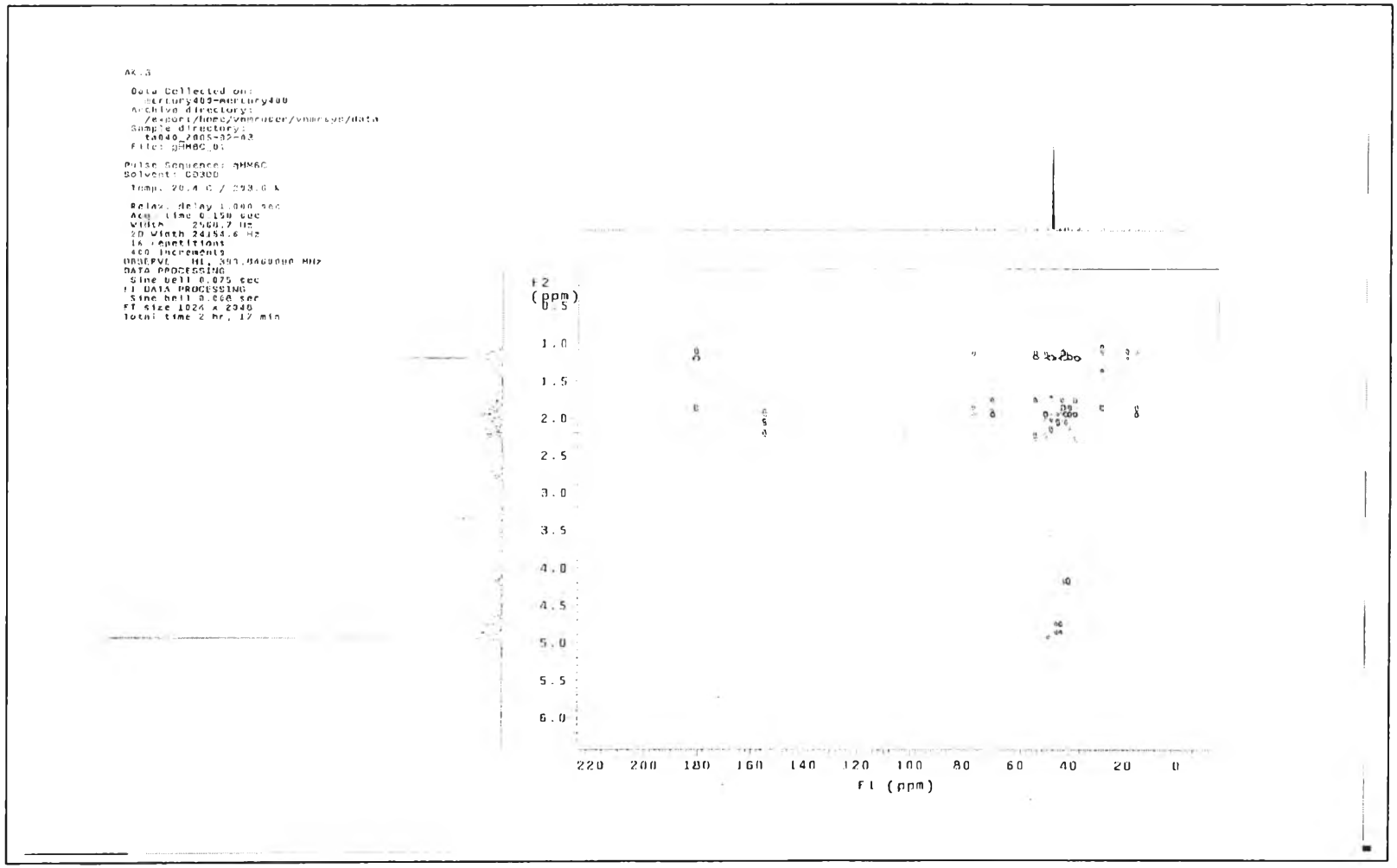

Figure B31. The gHMBC spectrum of Metabolite **1b**.

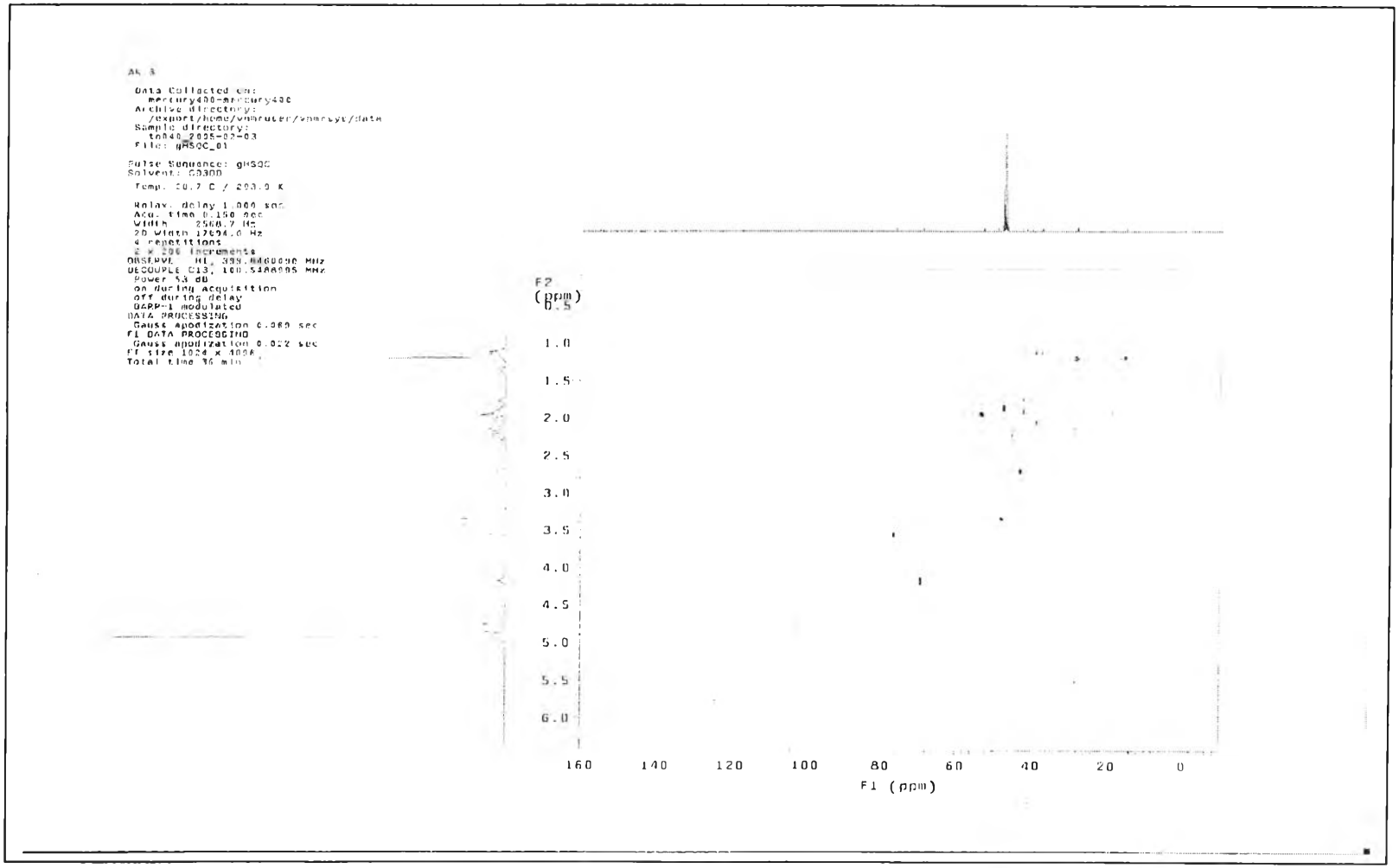

Figure B32. The gHSQC spectrum of Metabolite **1b**.

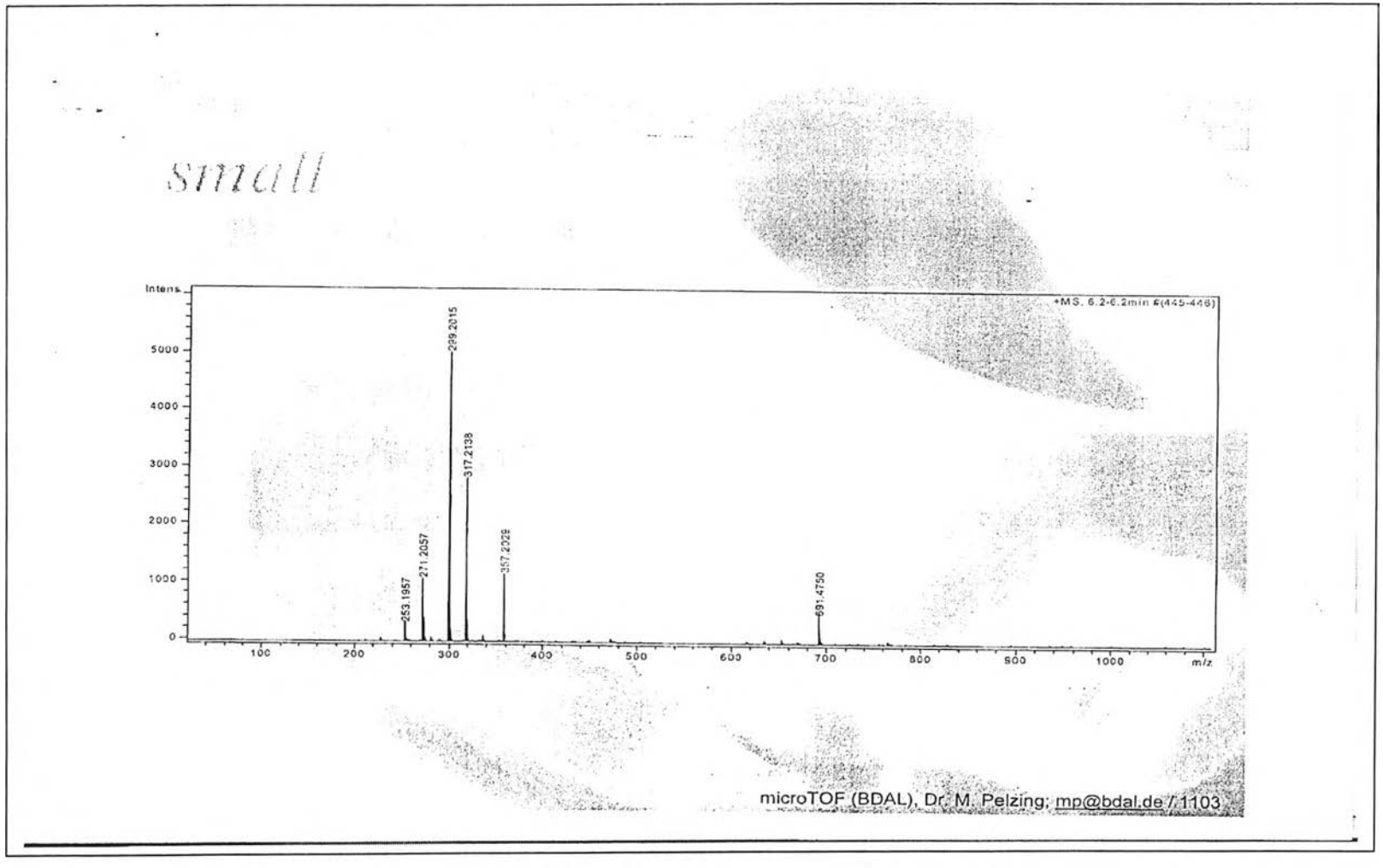

Figure B33. The LC-MS spectrum of Metabolite **1b**

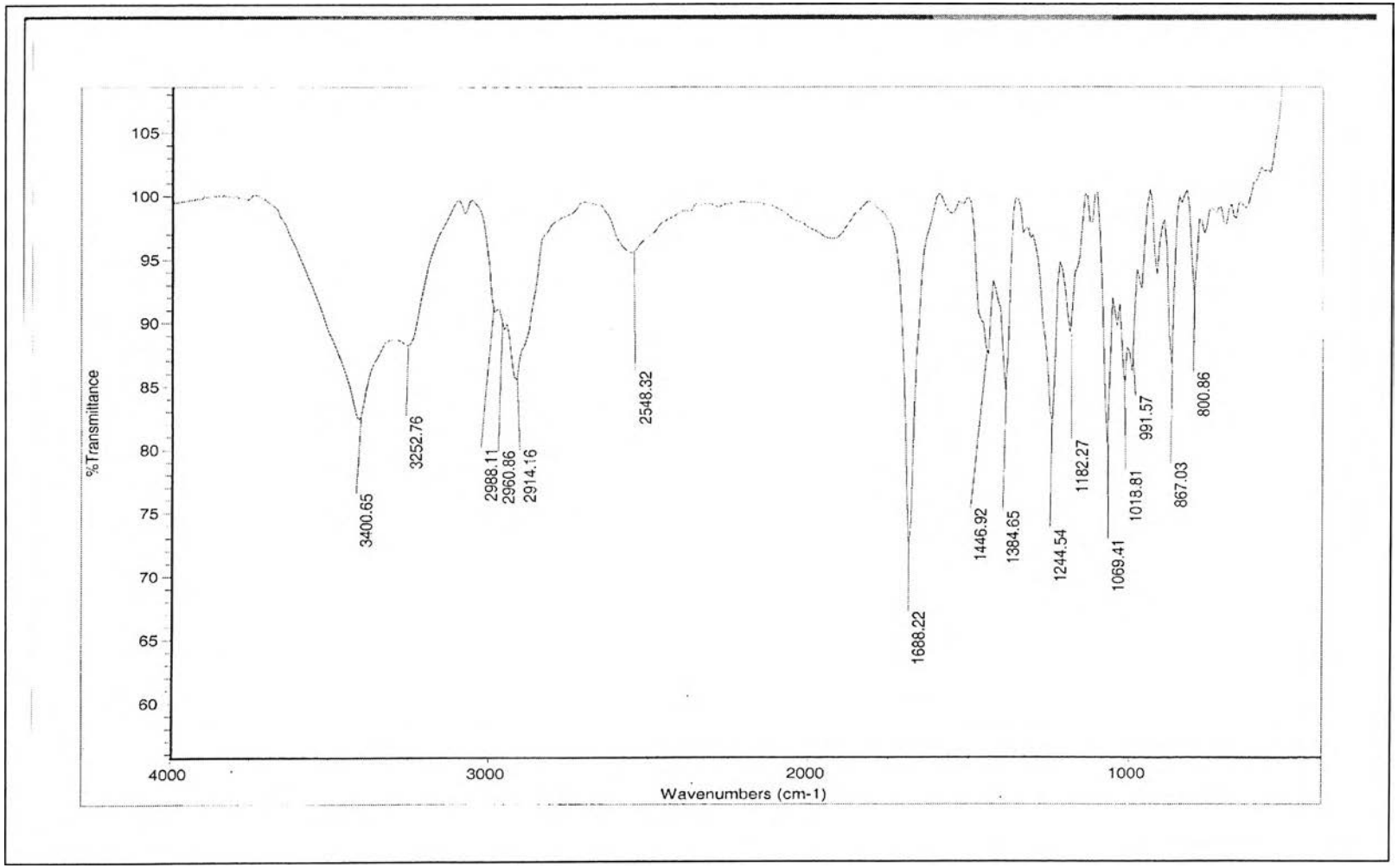

Figure B34. The IR spectrum of Metabolite **1c**.

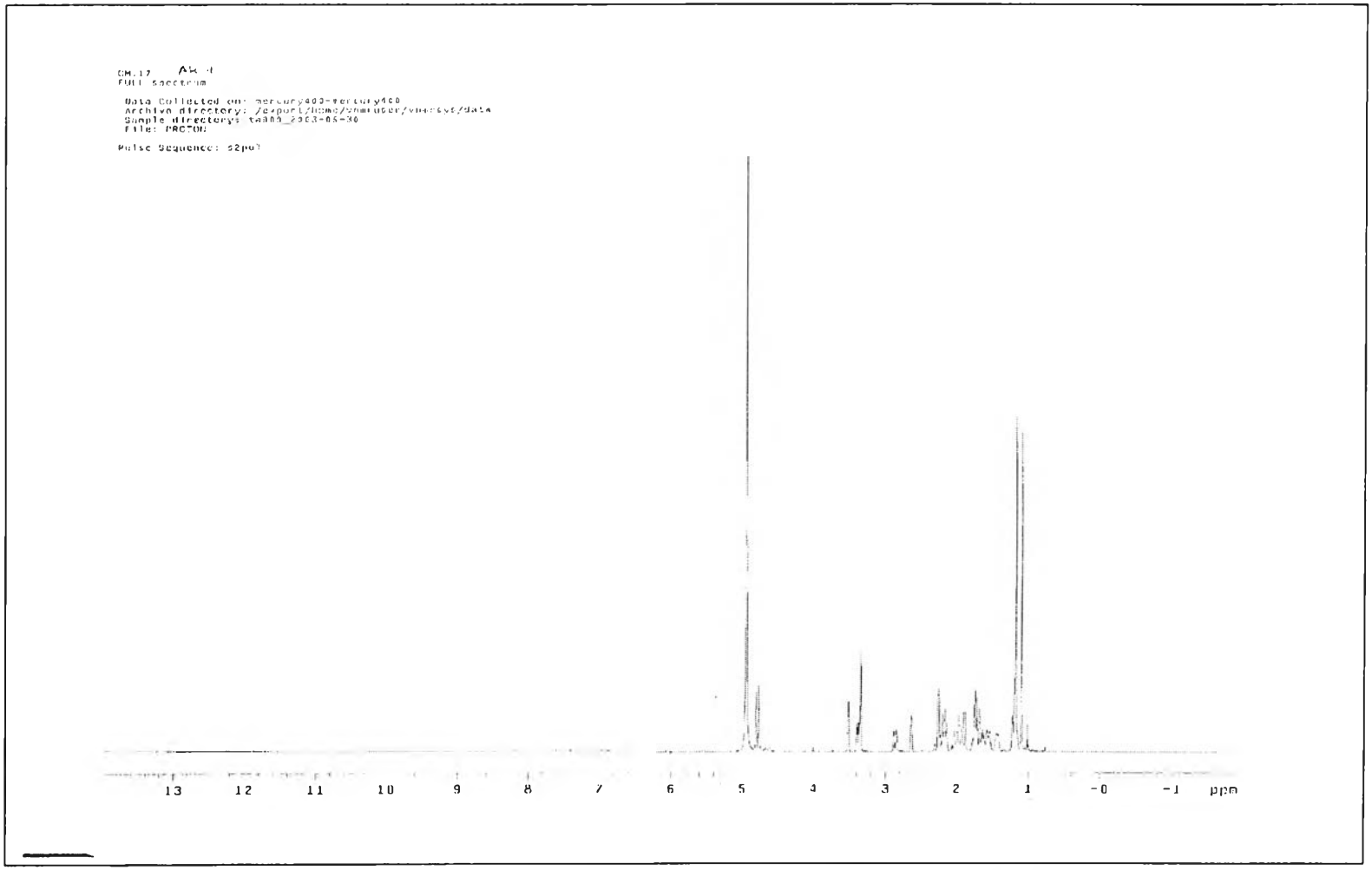

Figure B35. The ^{1}H-NMR spectrum of Metabolite **1c**.

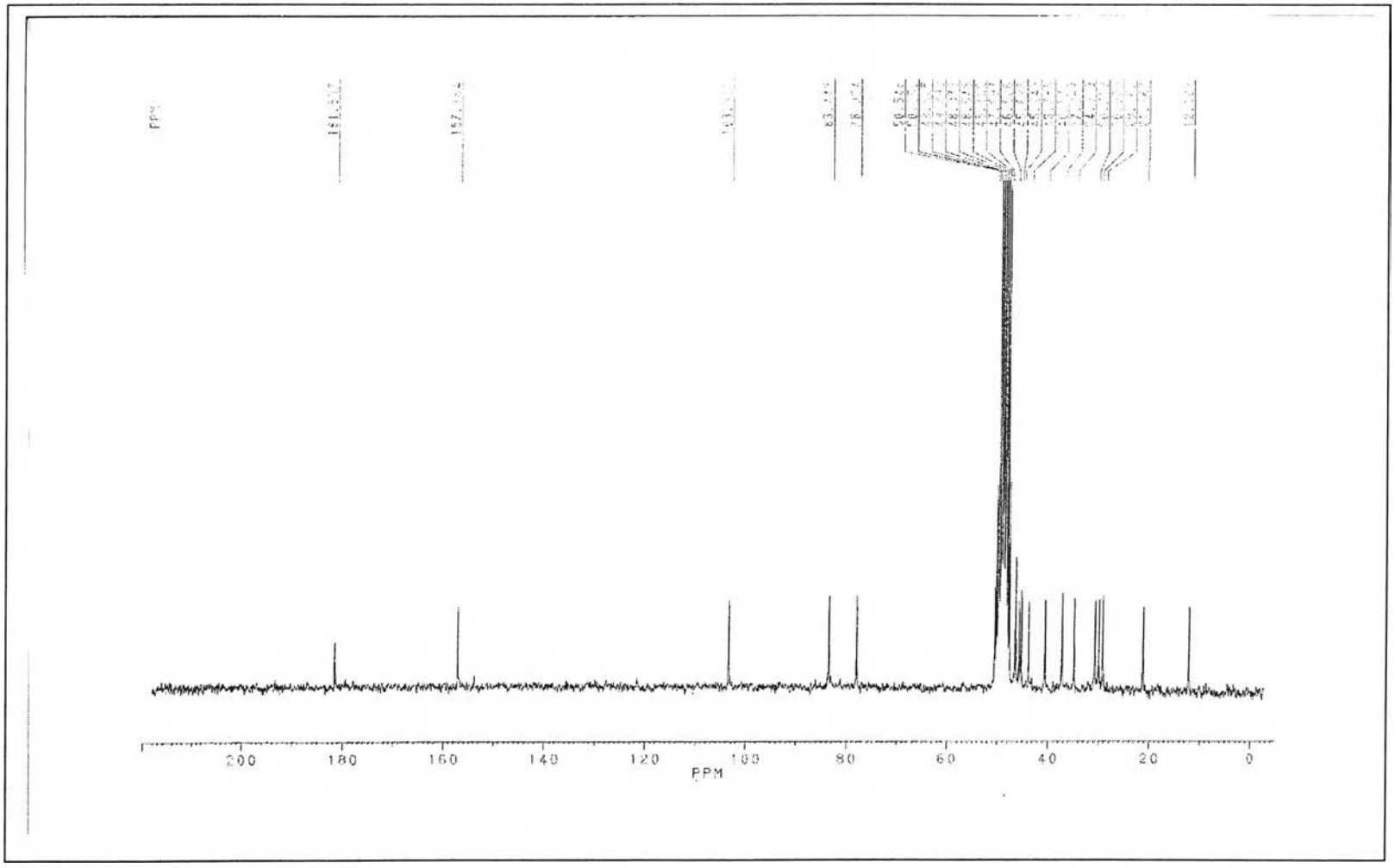

Figure B36. The ^{13}C-NMR spectrum of Metabolite **1c**.

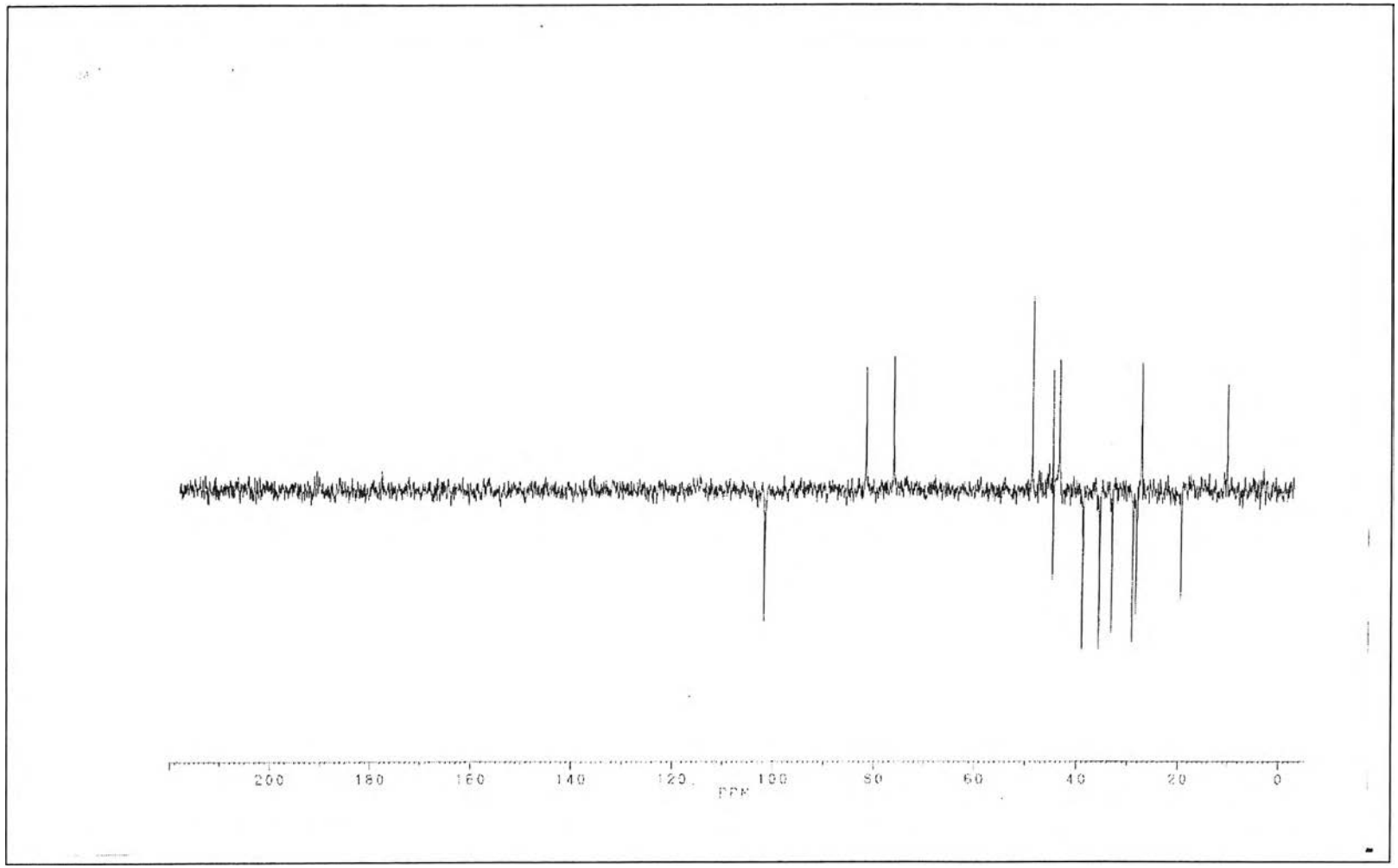

Figure B37. The DEPT spectrum of Metabolite **1c**.

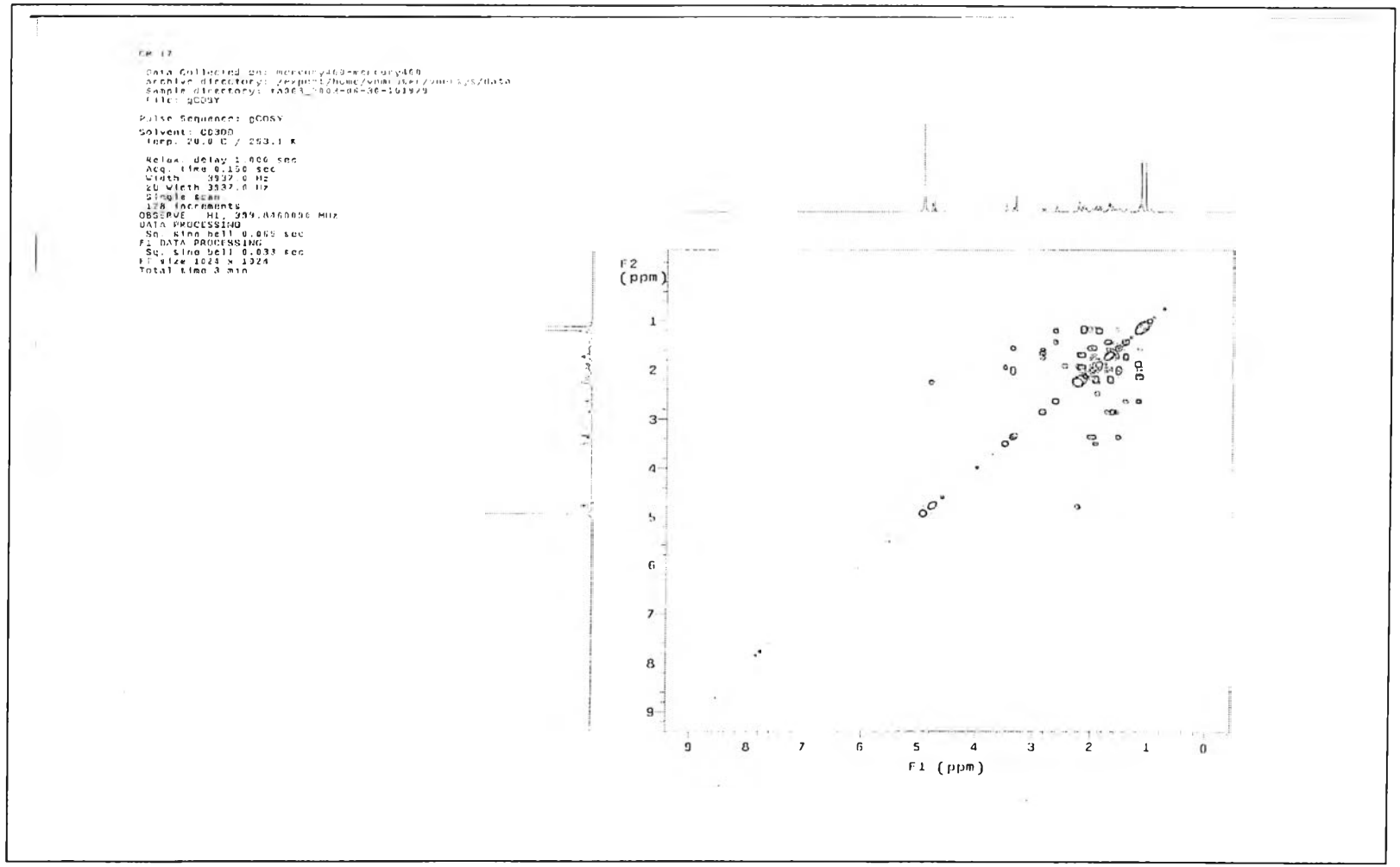

Figure B38. The gCOSY spectrum of Metabolite **1c**.

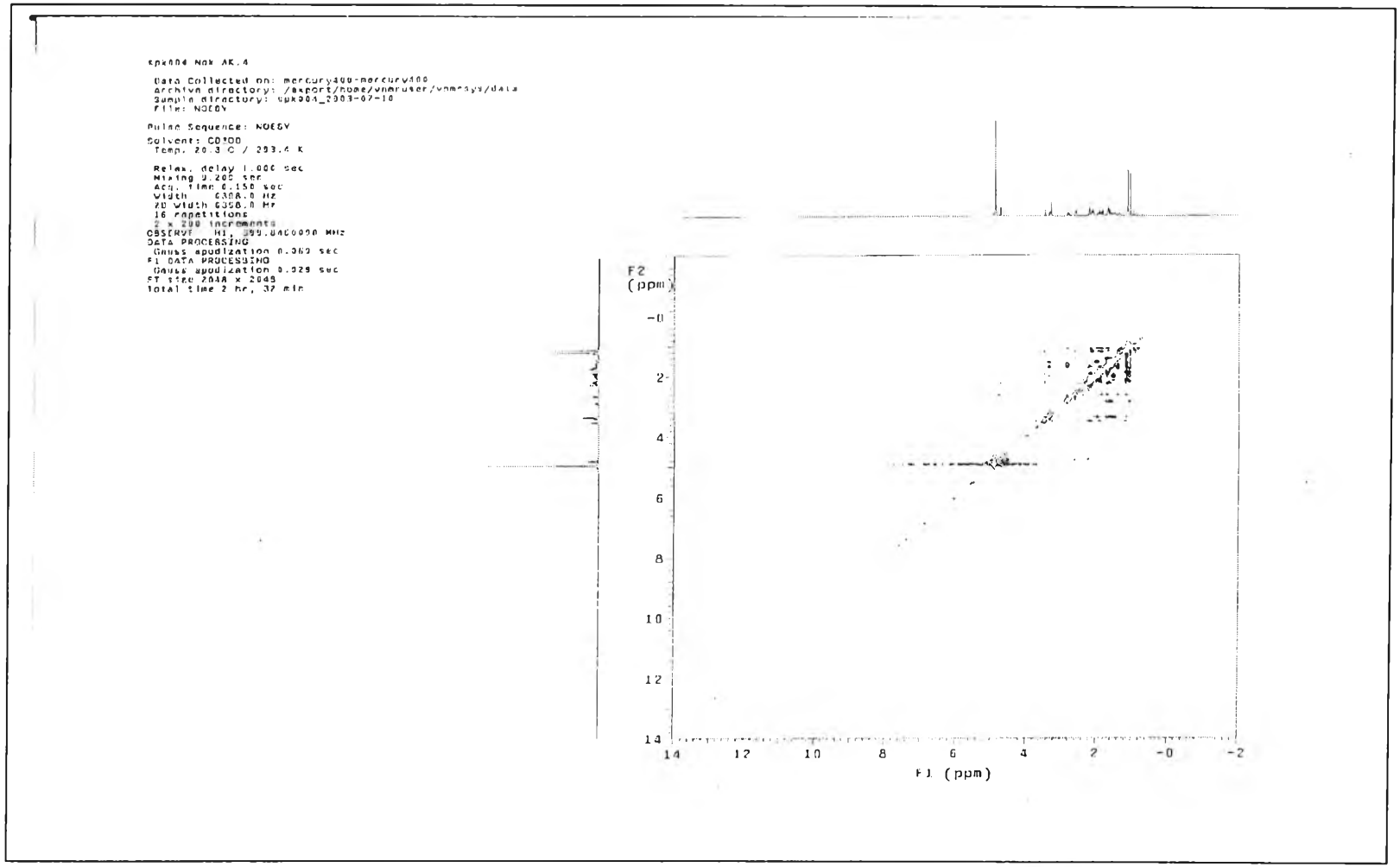

Figure B39. The gNOESY spectrum of Metabolite **1c**.

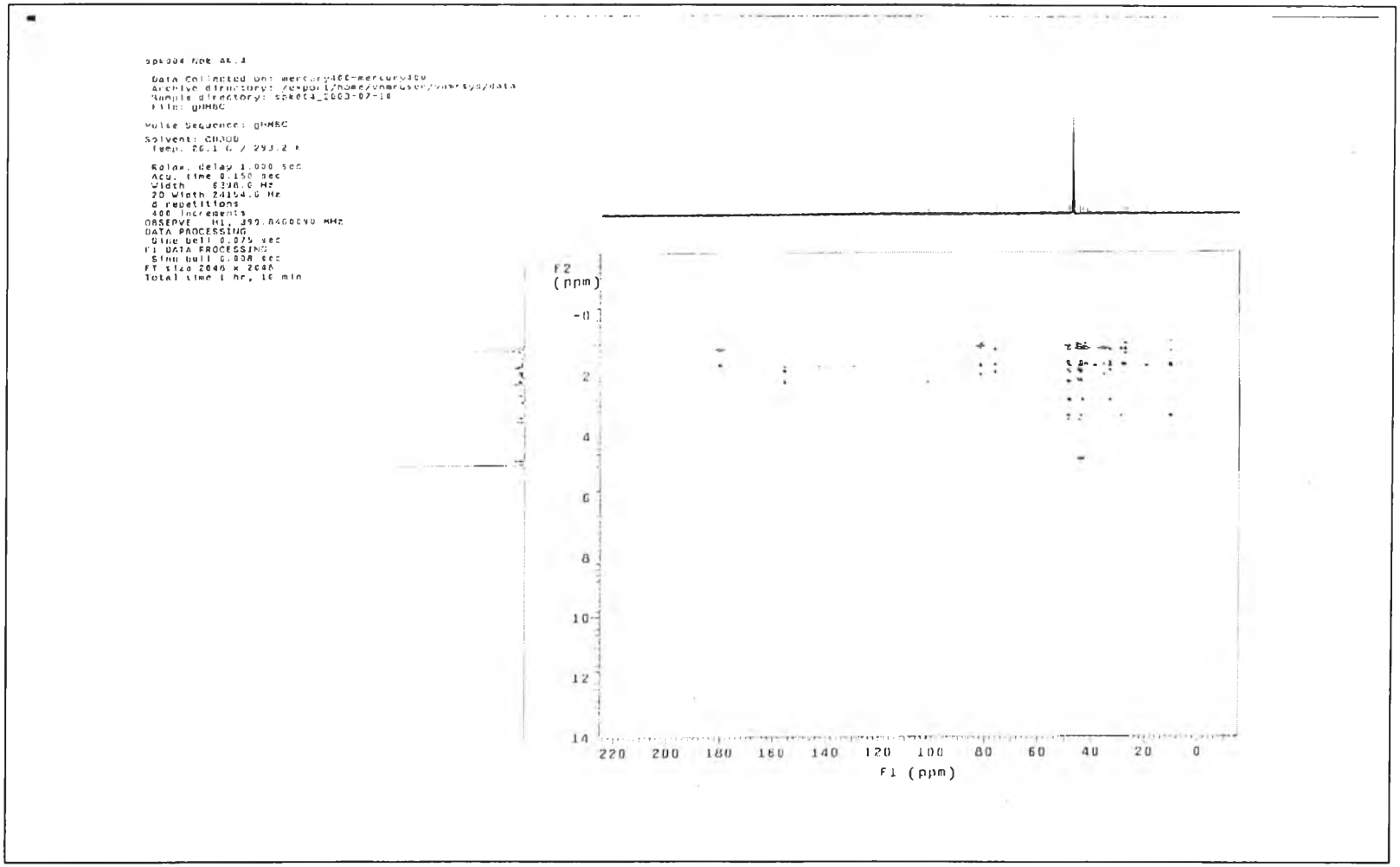

Figure B40. The gHMBC spectrum of Metabolite **1c**.

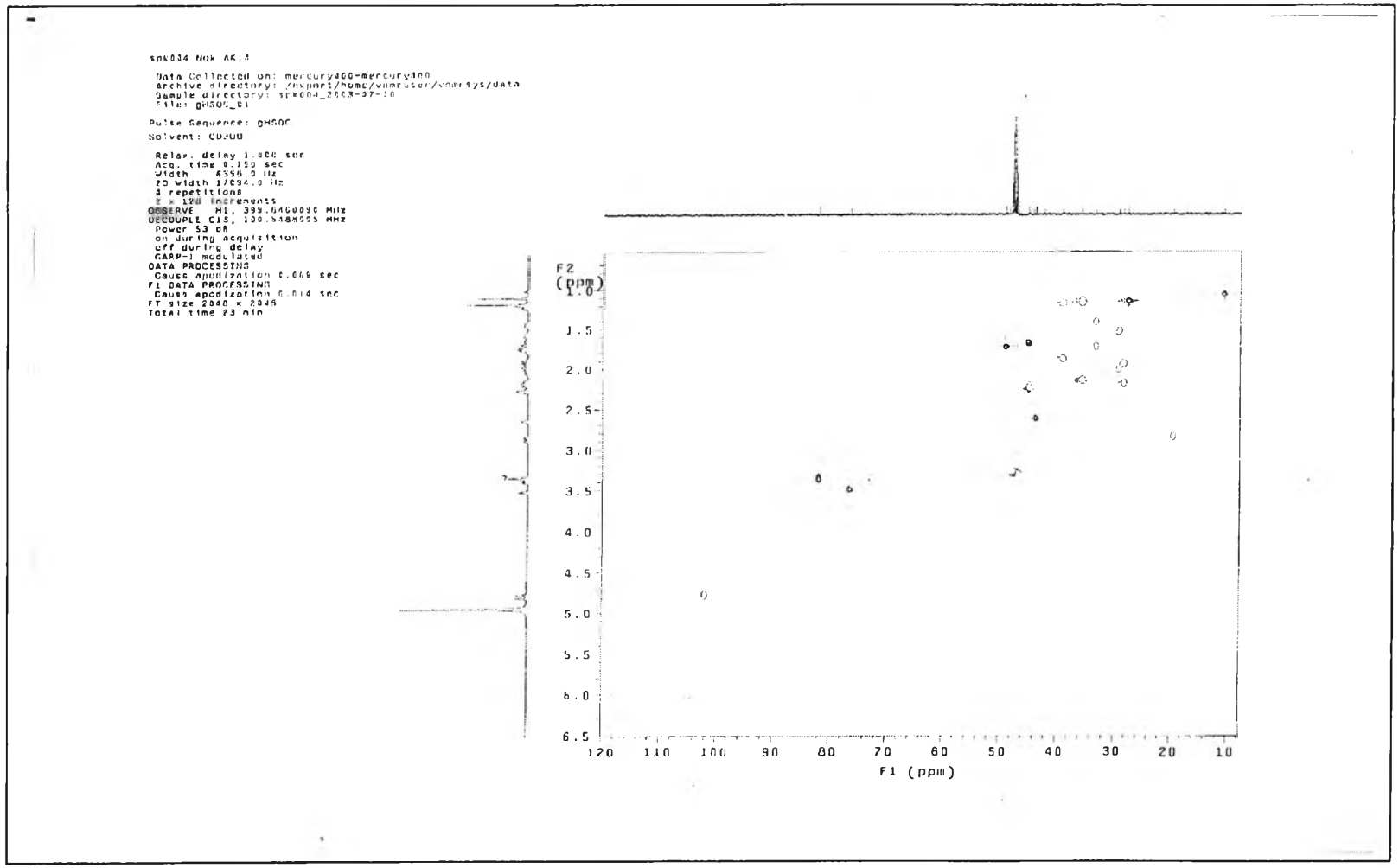

Figure B41. The gHSQC spectrum of Metabolite **1c**.

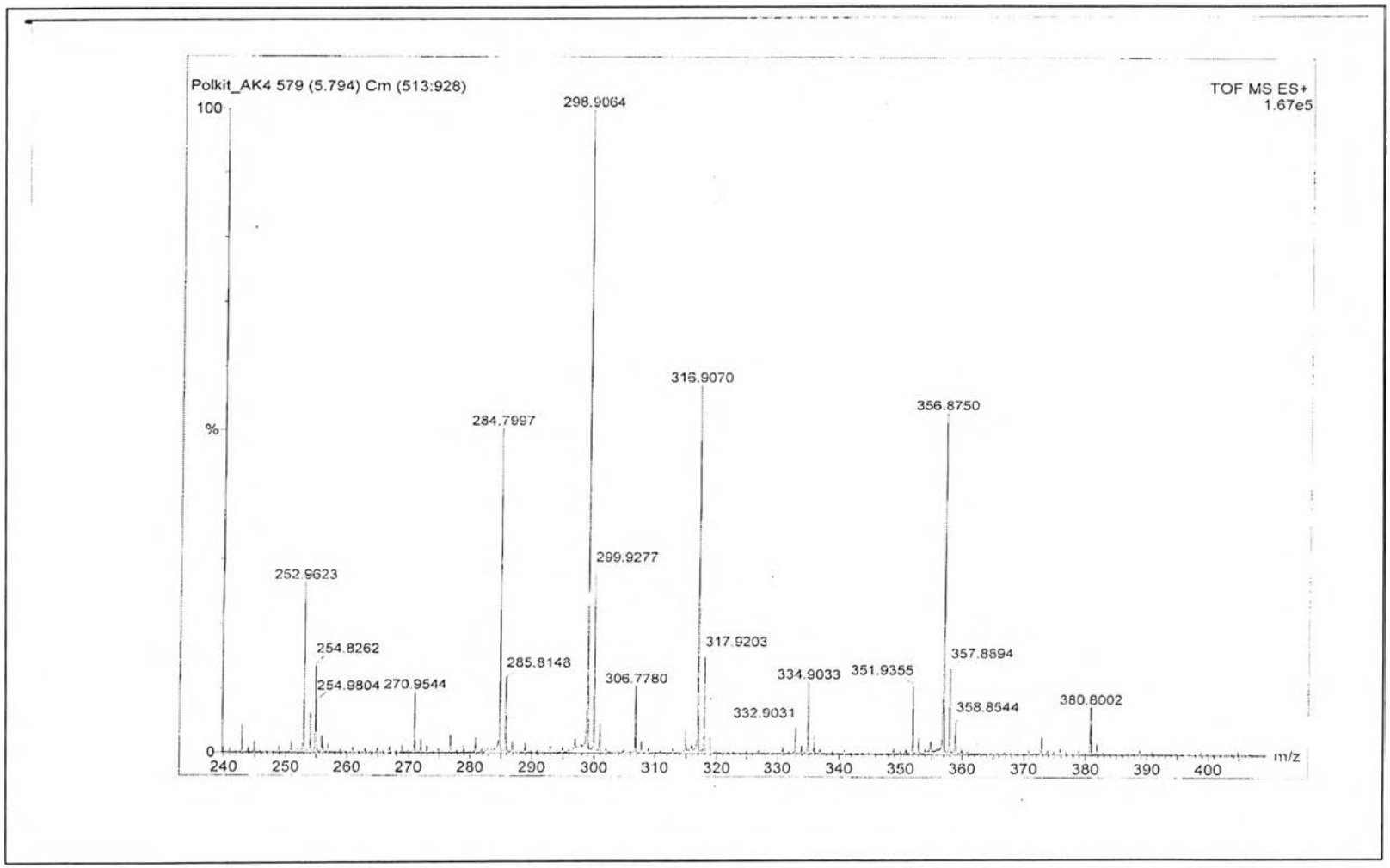

Figure B42. The LC-MS spectrum of Metabolite **1c**.

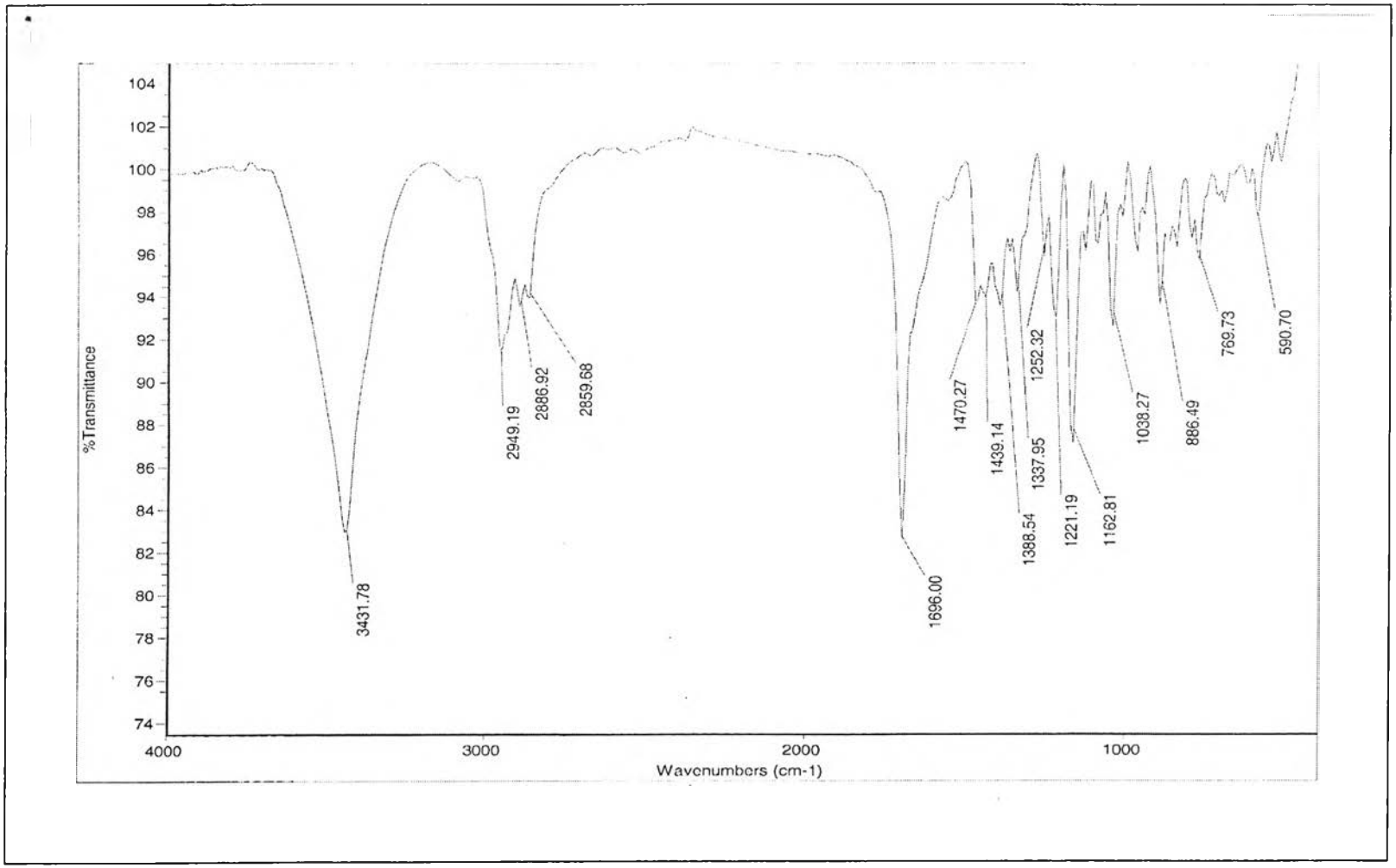

Figure B43. The IR spectrum of Metabolite **1d**.

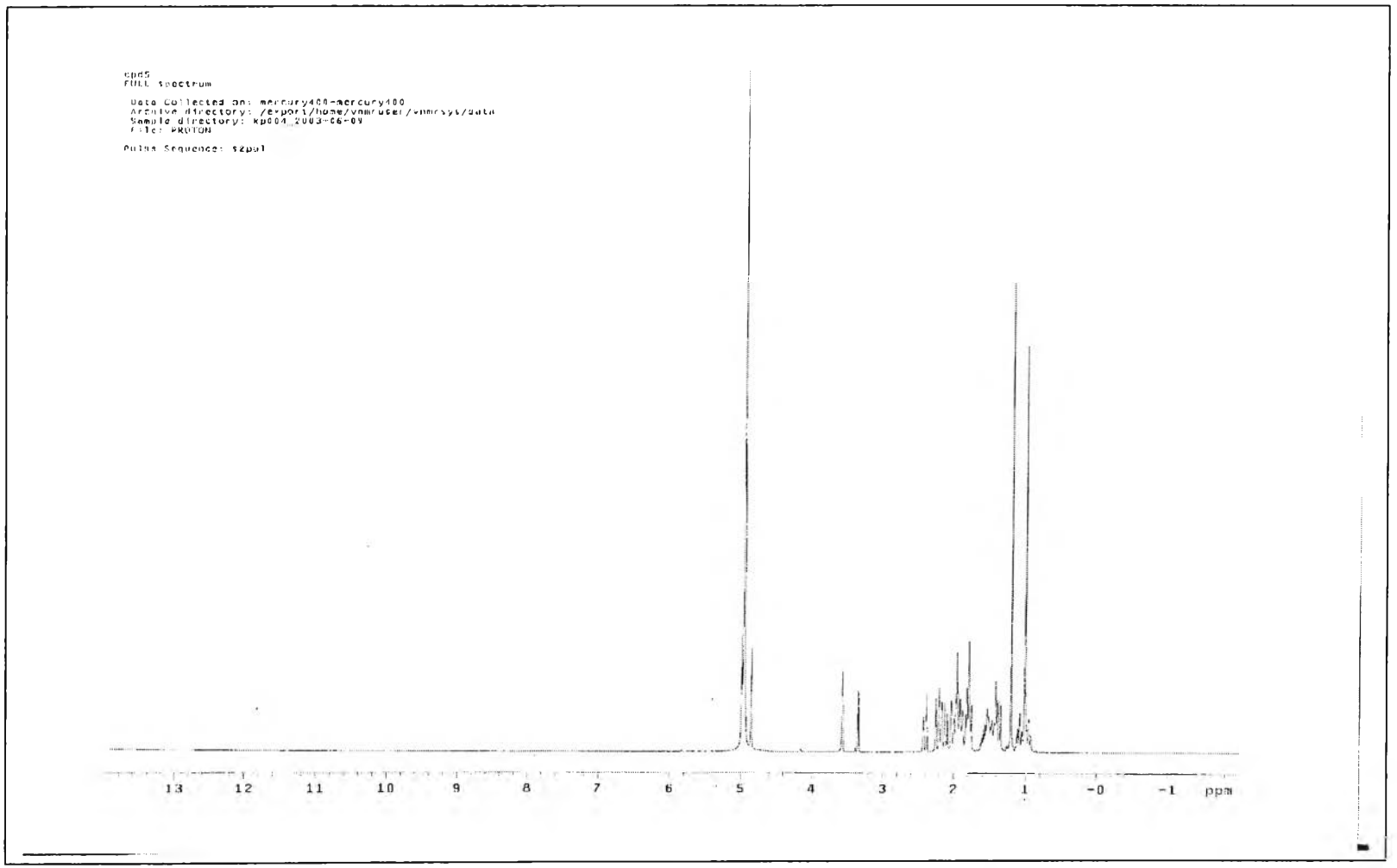

Figure B44. The ^{1}H-NMR spectrum of Metabolite **1d**.

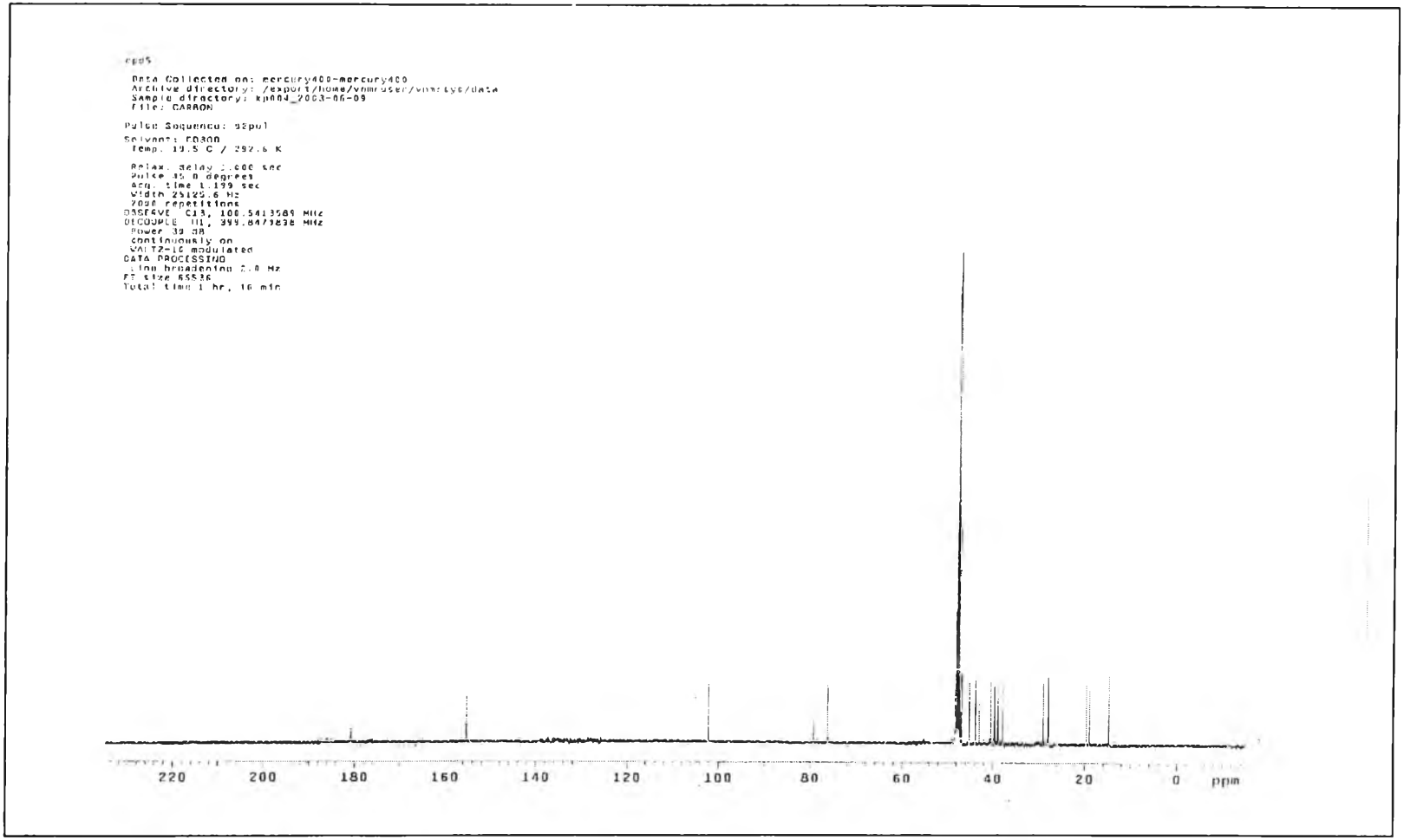

Figure B45. The ^{13}C-NMR spectrum of Metabolite **1d**.

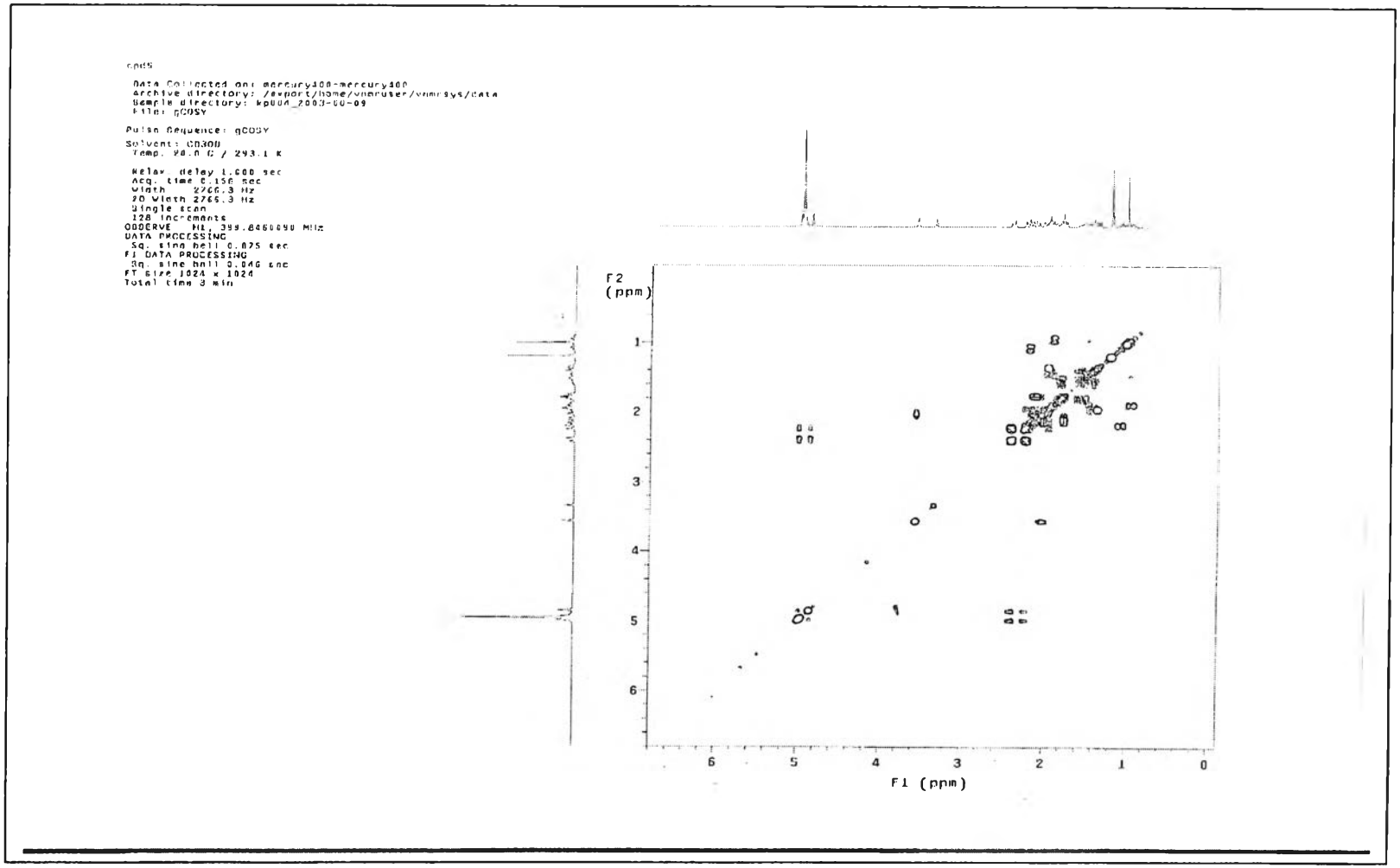

Figure B46. The gCOSY spectrum of Metabolite **1d**.

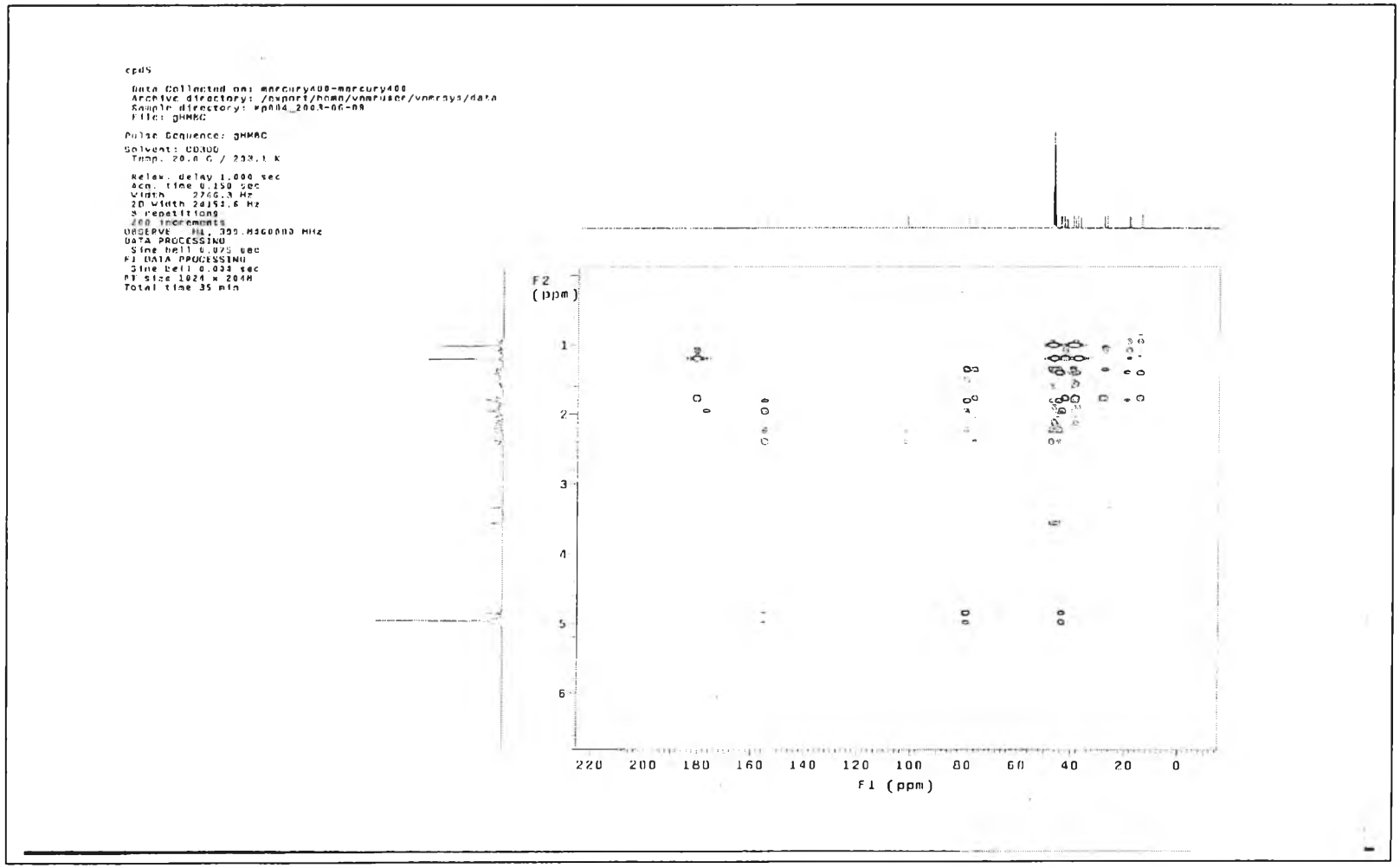

Figure B47. The gHMBC spectrum of Metabolite **1d**.

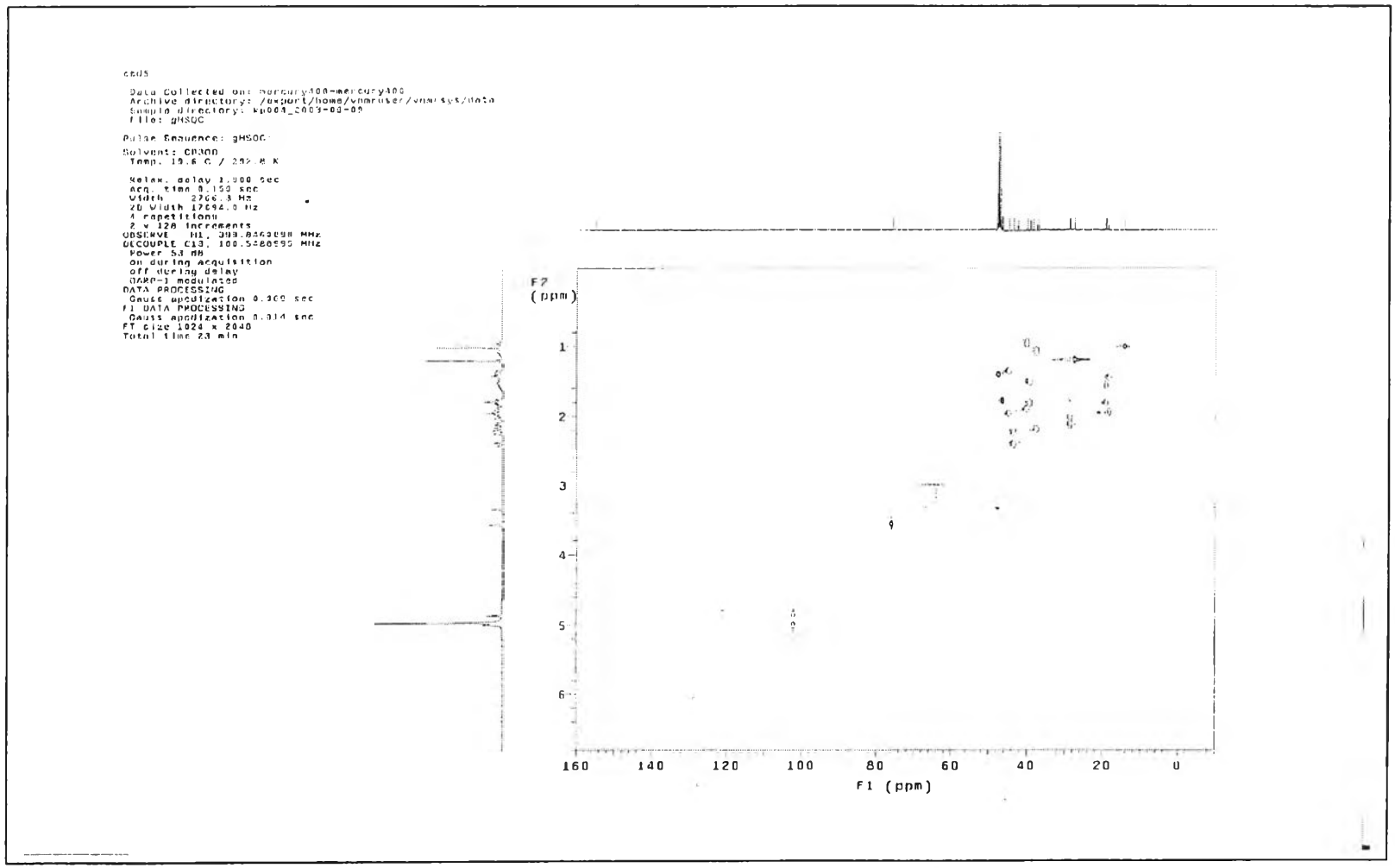

Figure B48. The gHSQC spectrum of Metabolite **1d**.

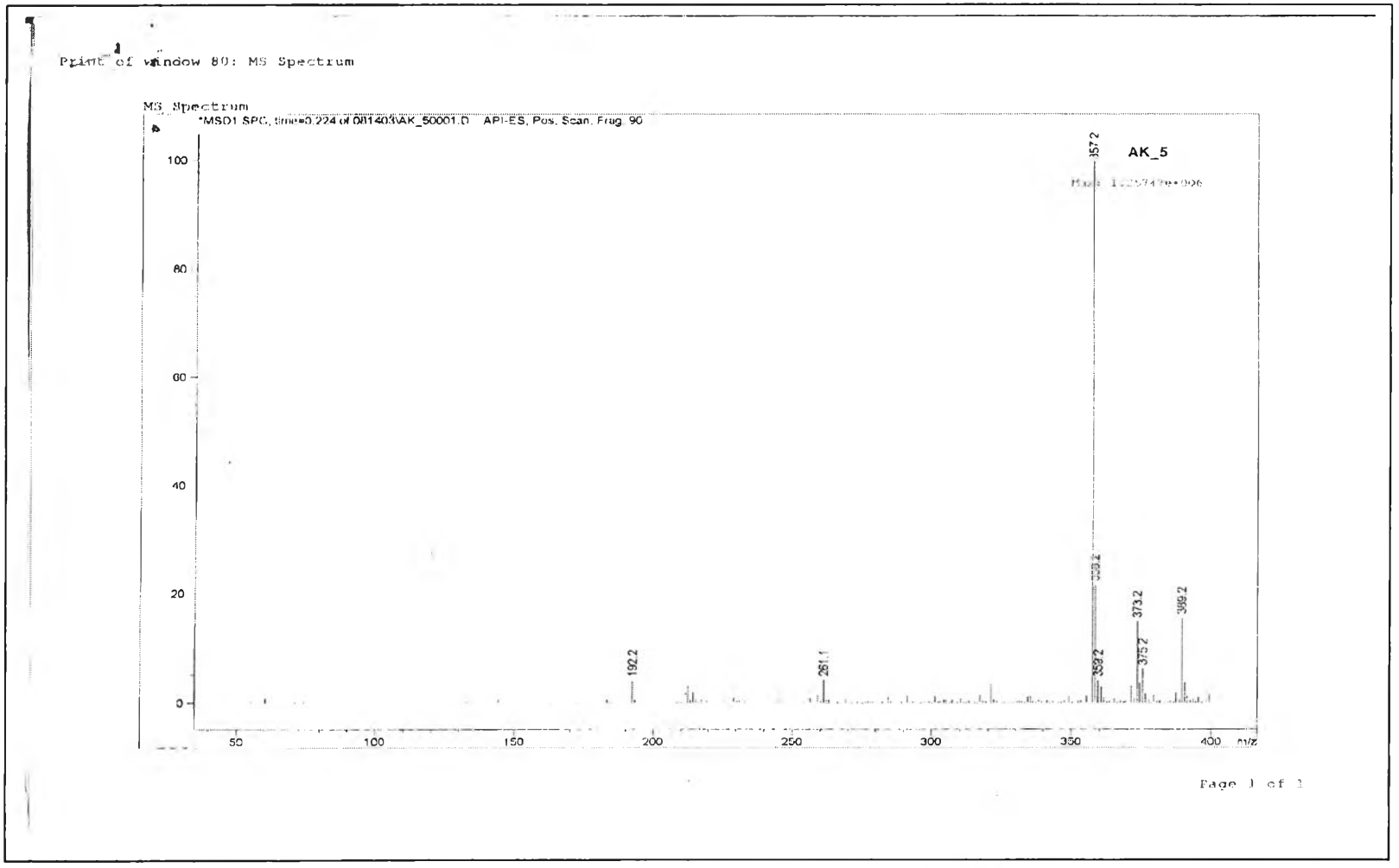

Figure B49. The LC-MS spectrum of Metabolite **1d**.

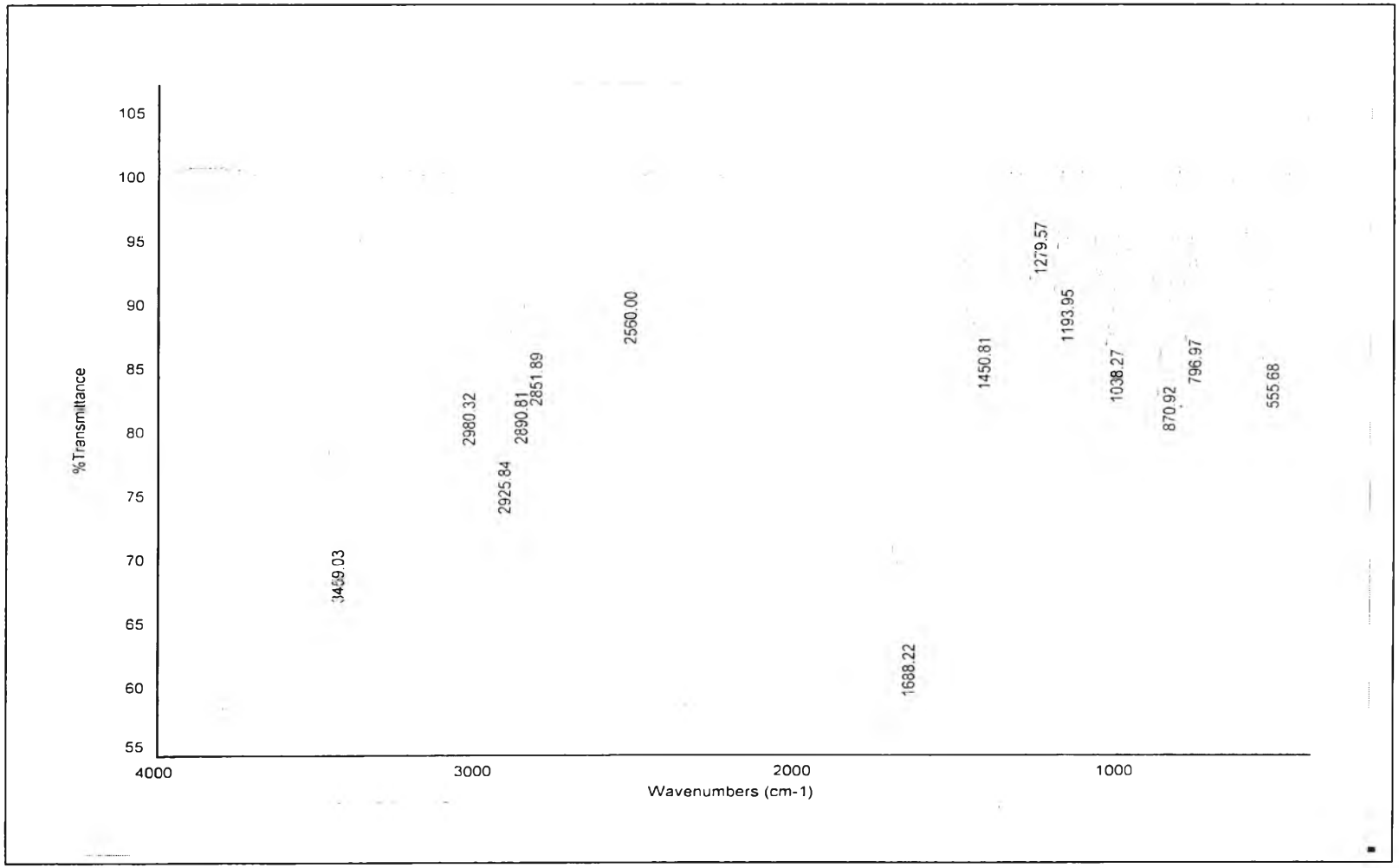

Figure B50. The IR spectrum of Metabolite **1e**.

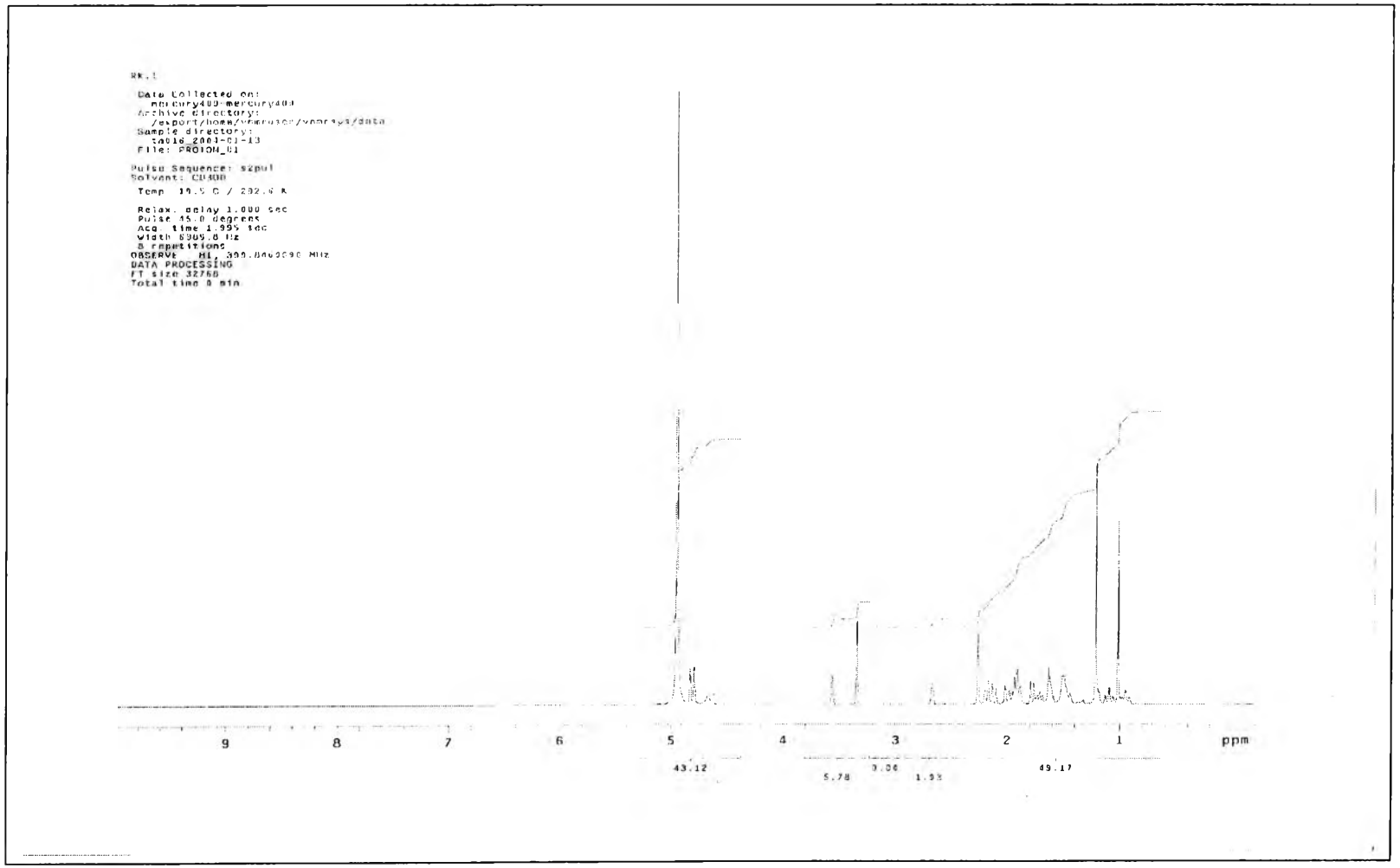

Figure B51. The ^{1}H-NMR spectrum of Metabolite **1e**.

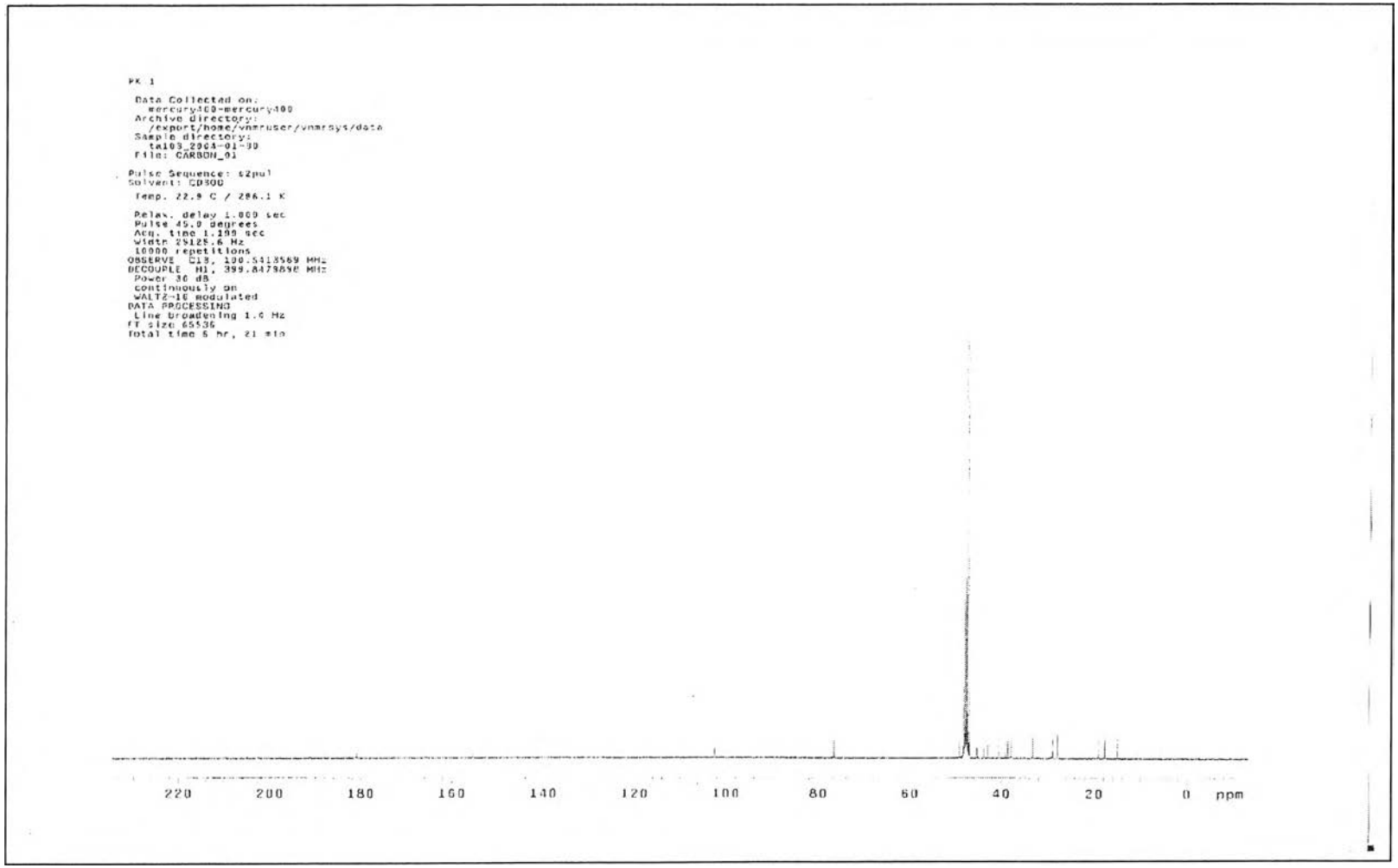

Figure B52. The ^{13}C-NMR spectrum of Metabolite **1e**.

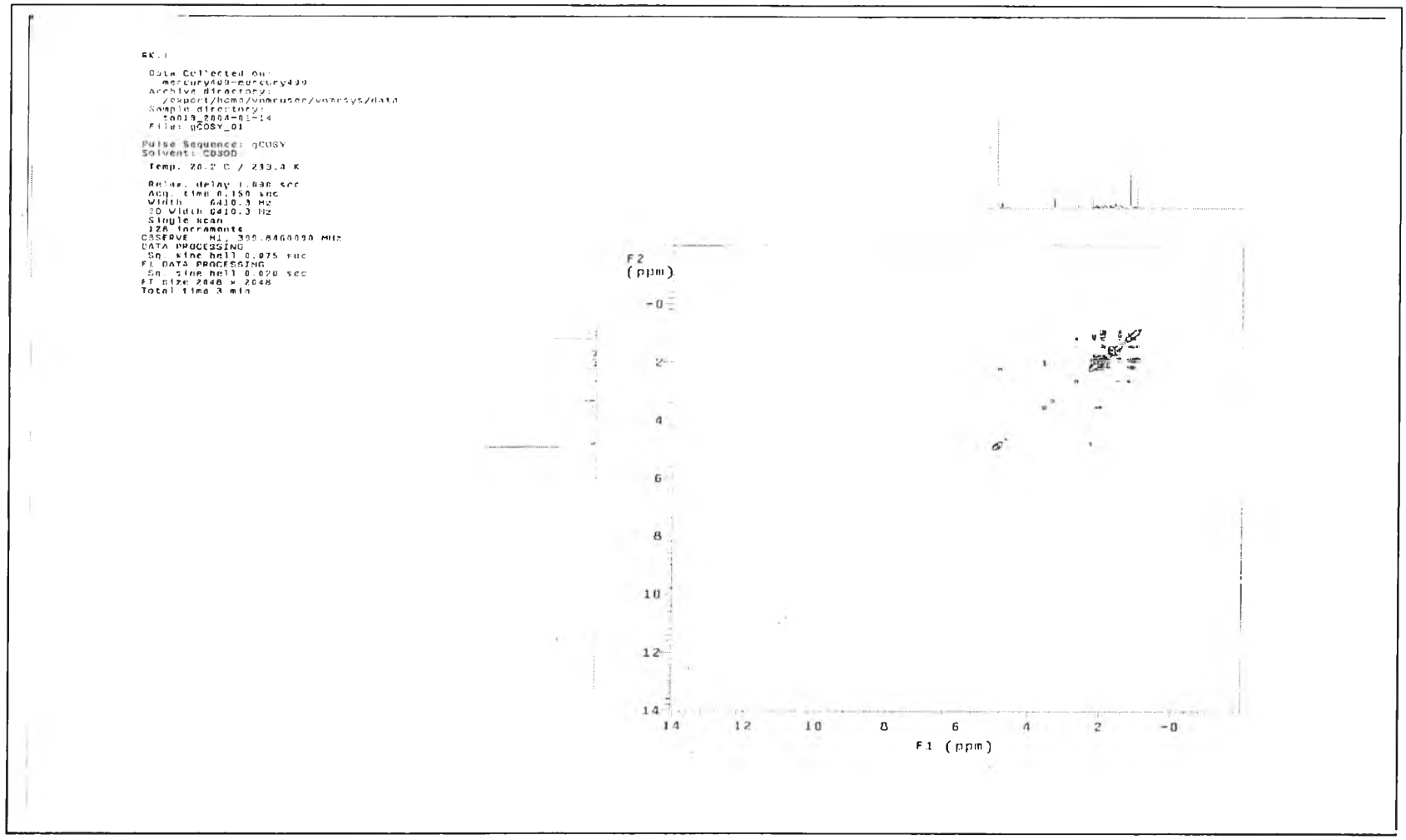

Figure D53. The gCOSY spectrum of Metabolite **1e**.

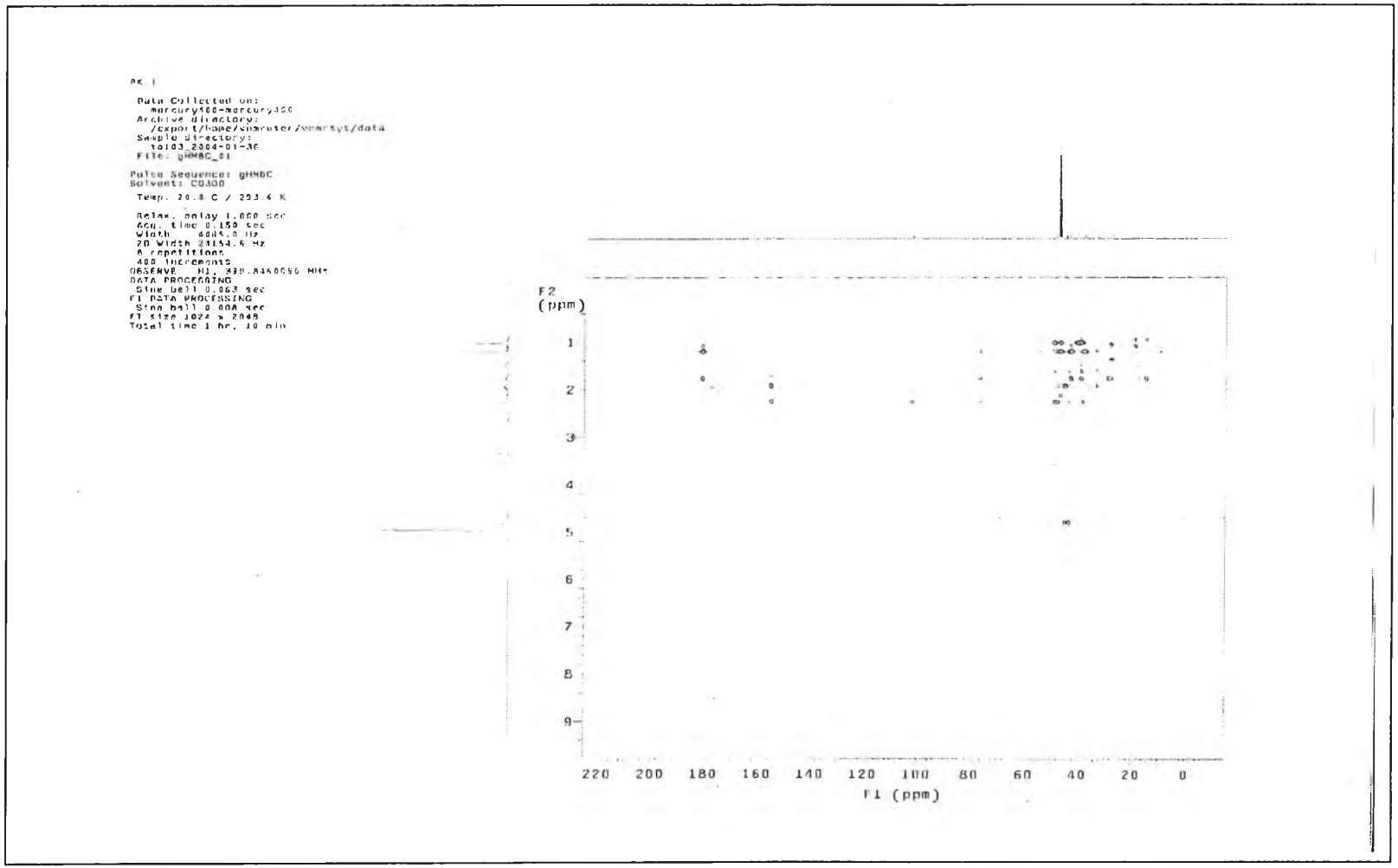

Figure B54. The HMBC spectrum of Metabolite **1e**.

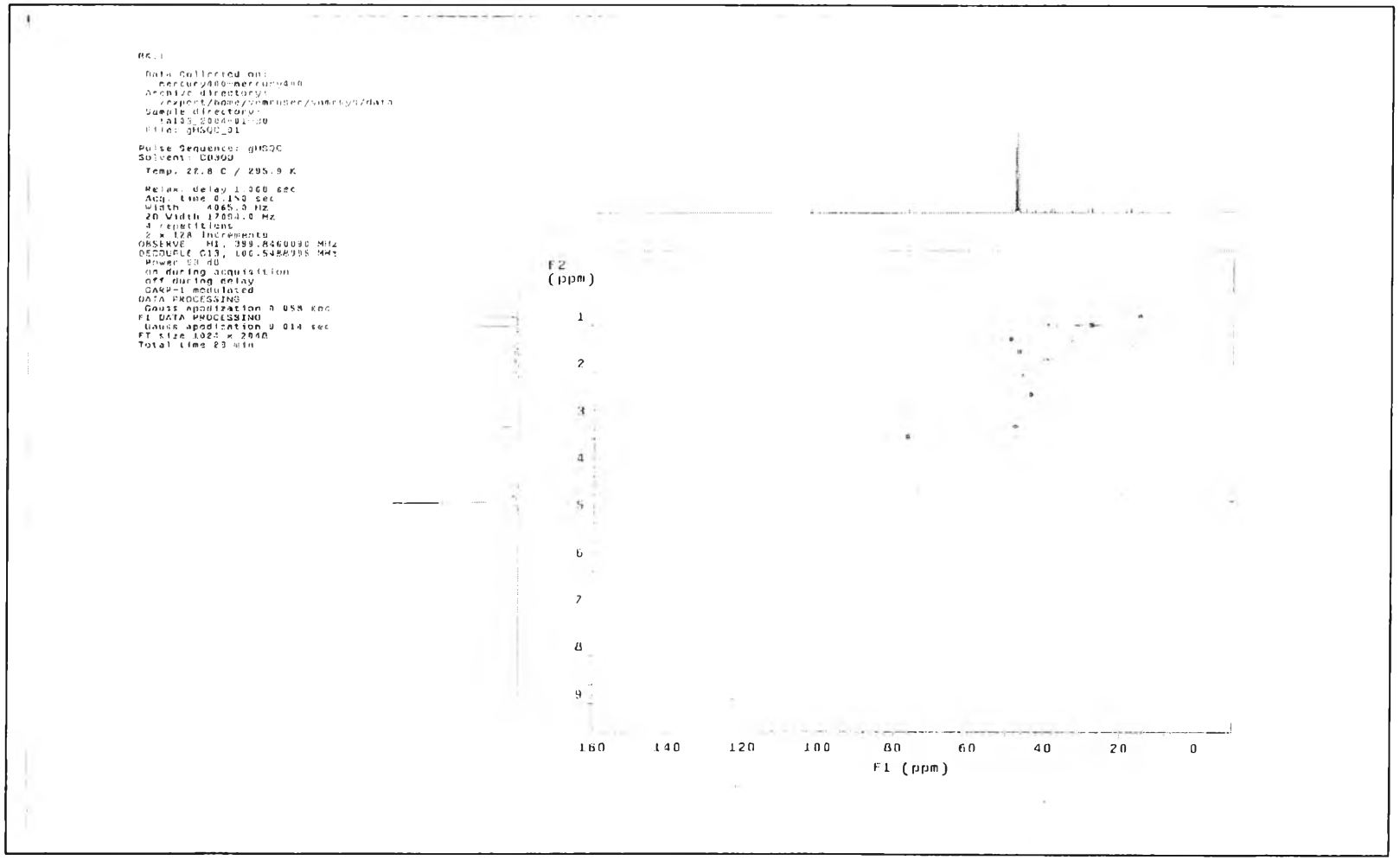

Figure B55. The gHSQC spectrum of Metabolite **1e**.

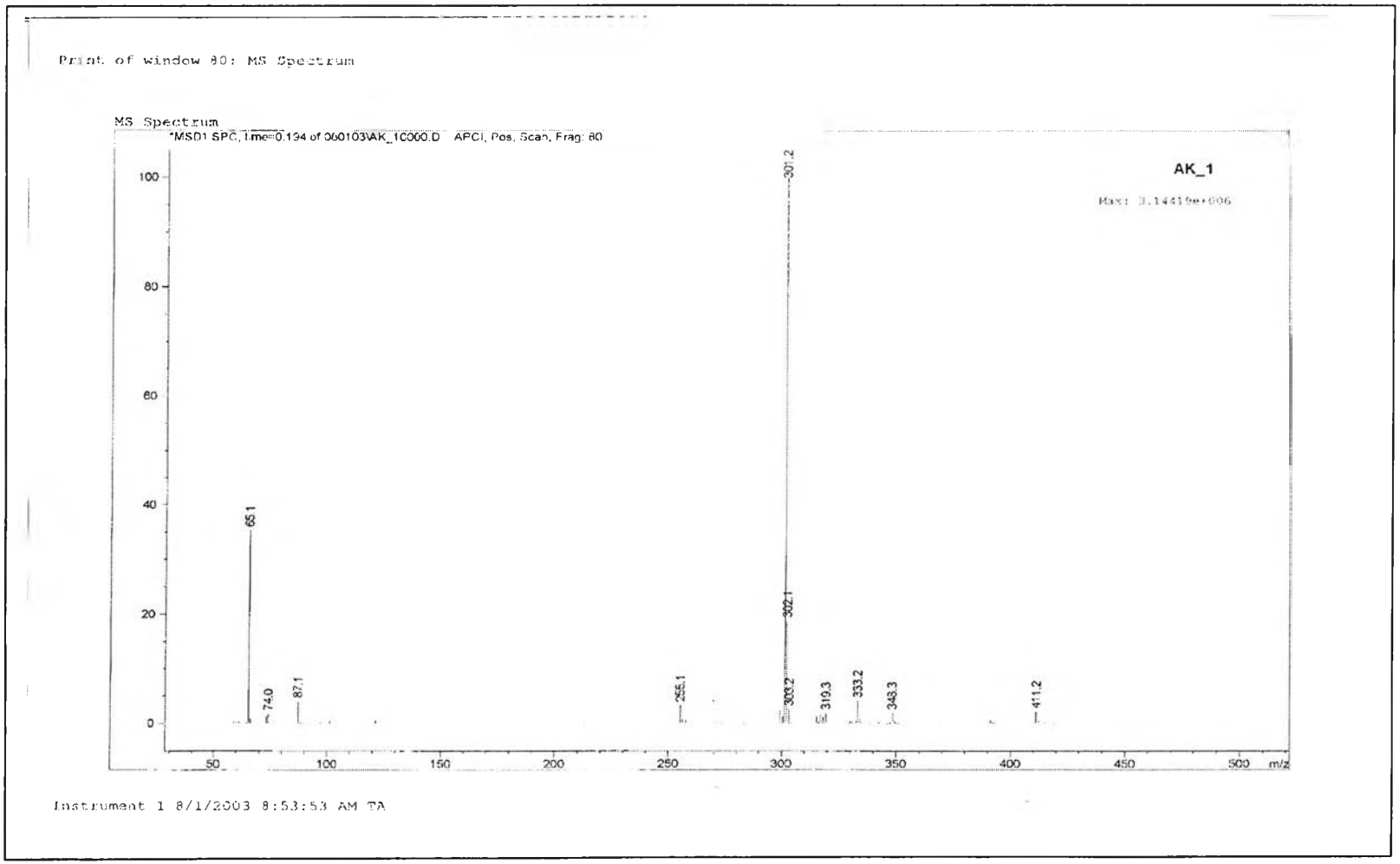

Figure B56. The LC-MS spectrum of Metabolite **1e**.

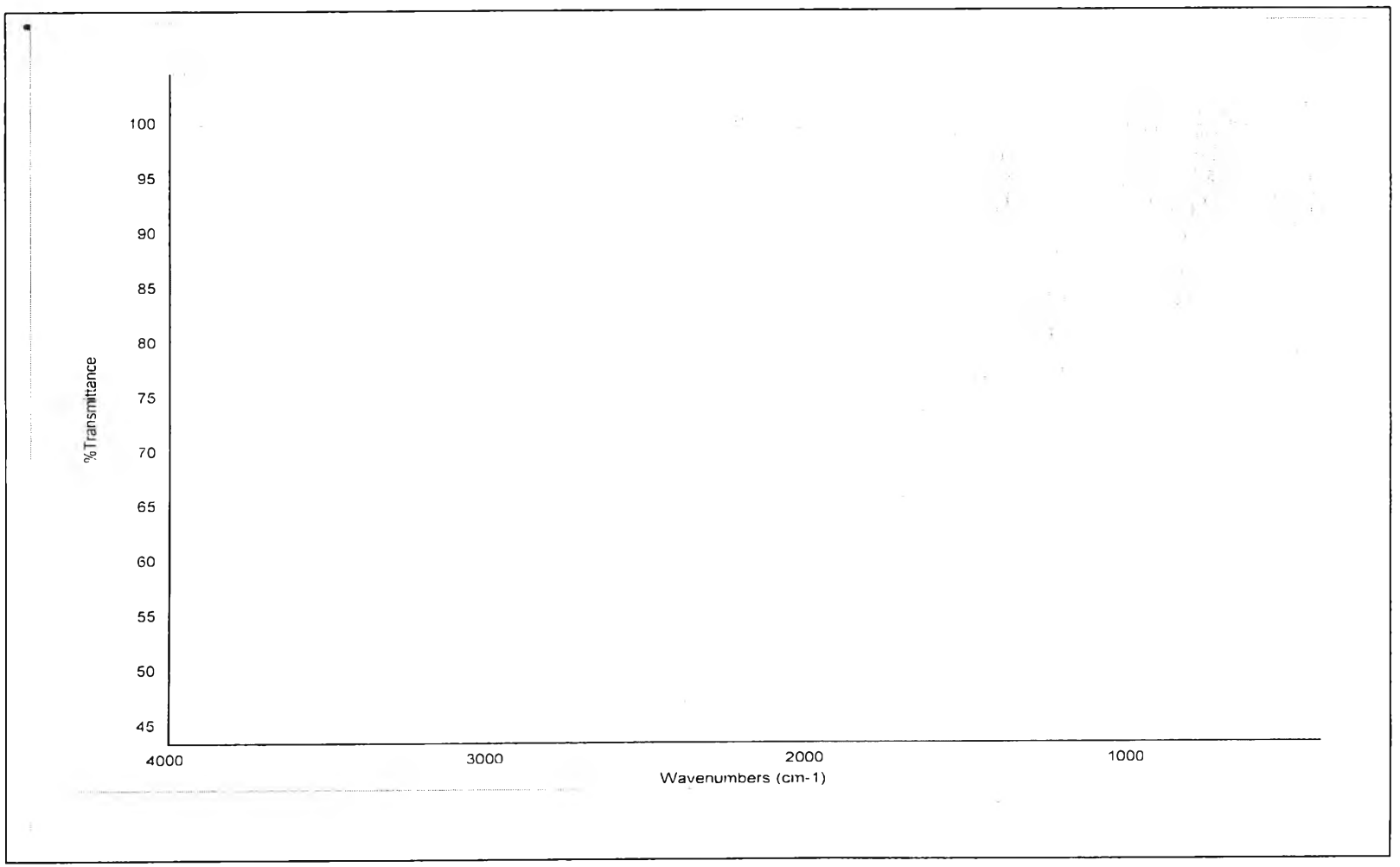

Figure B57. The IR spectrum of Metabolite **1f**.

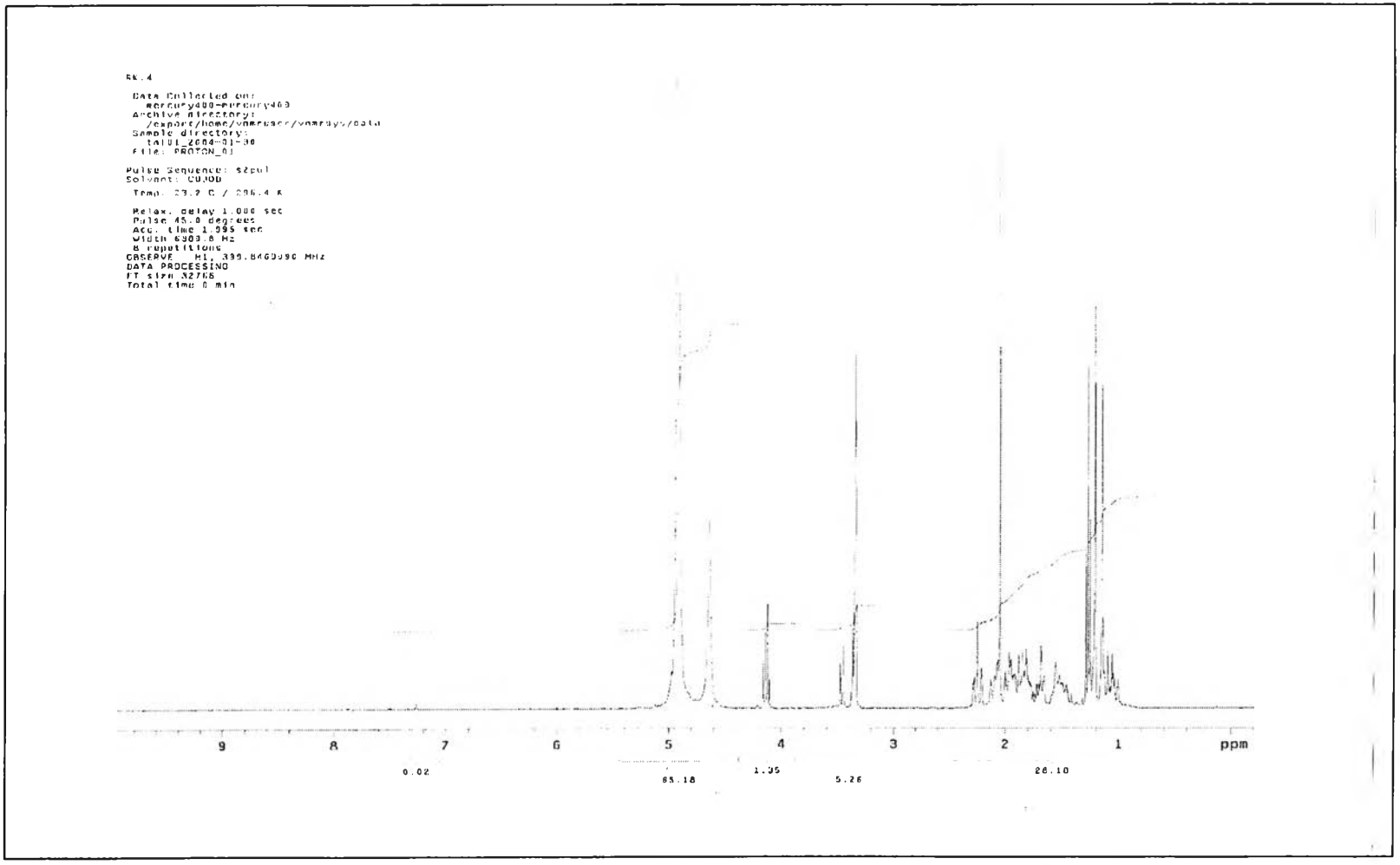

Figure B58. The ^{1}H-NMR spectrum of Metabolite **1f**.

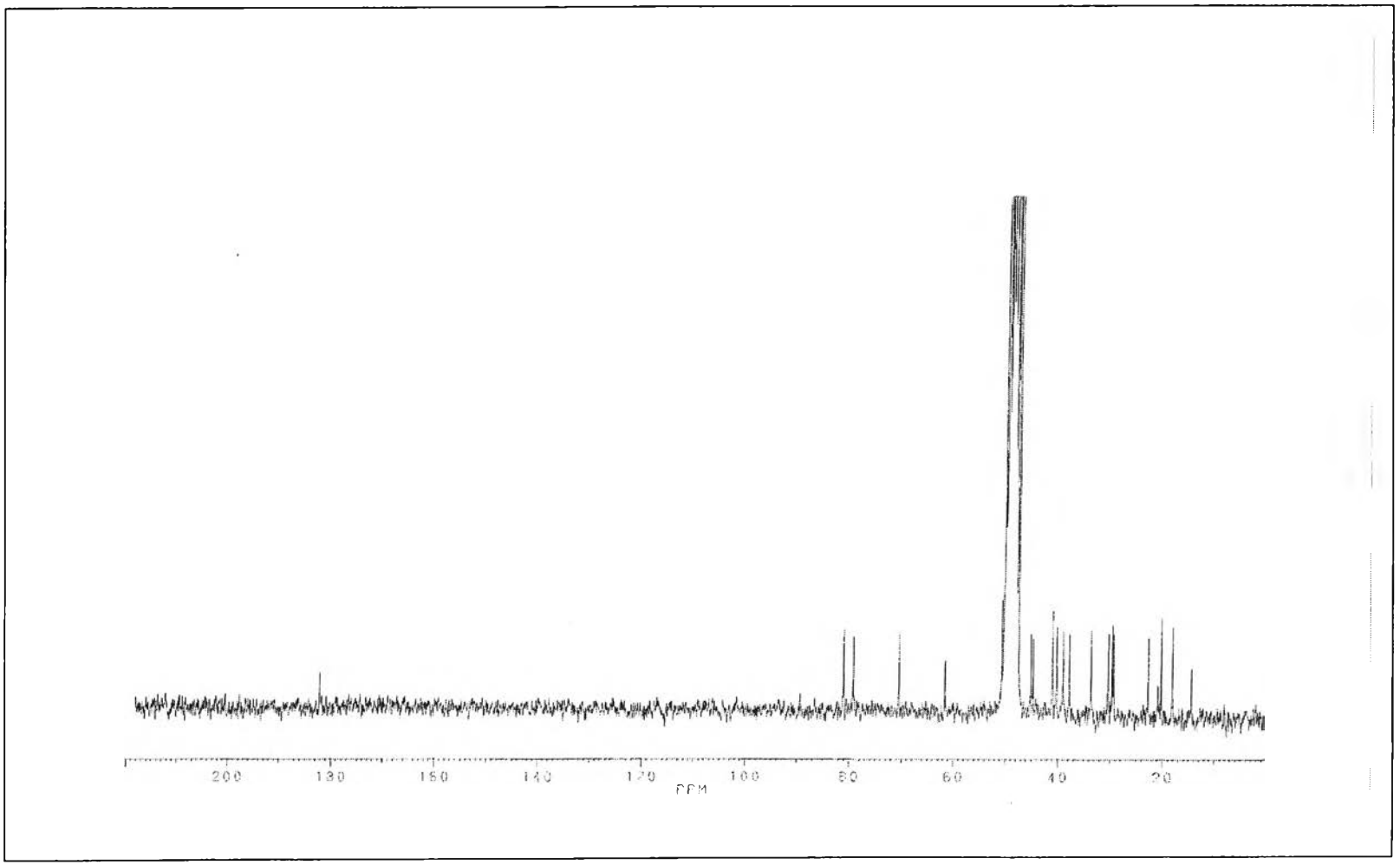

Figure B59. The ^{13}C-NMR spectrum of Metabolite **1f**.

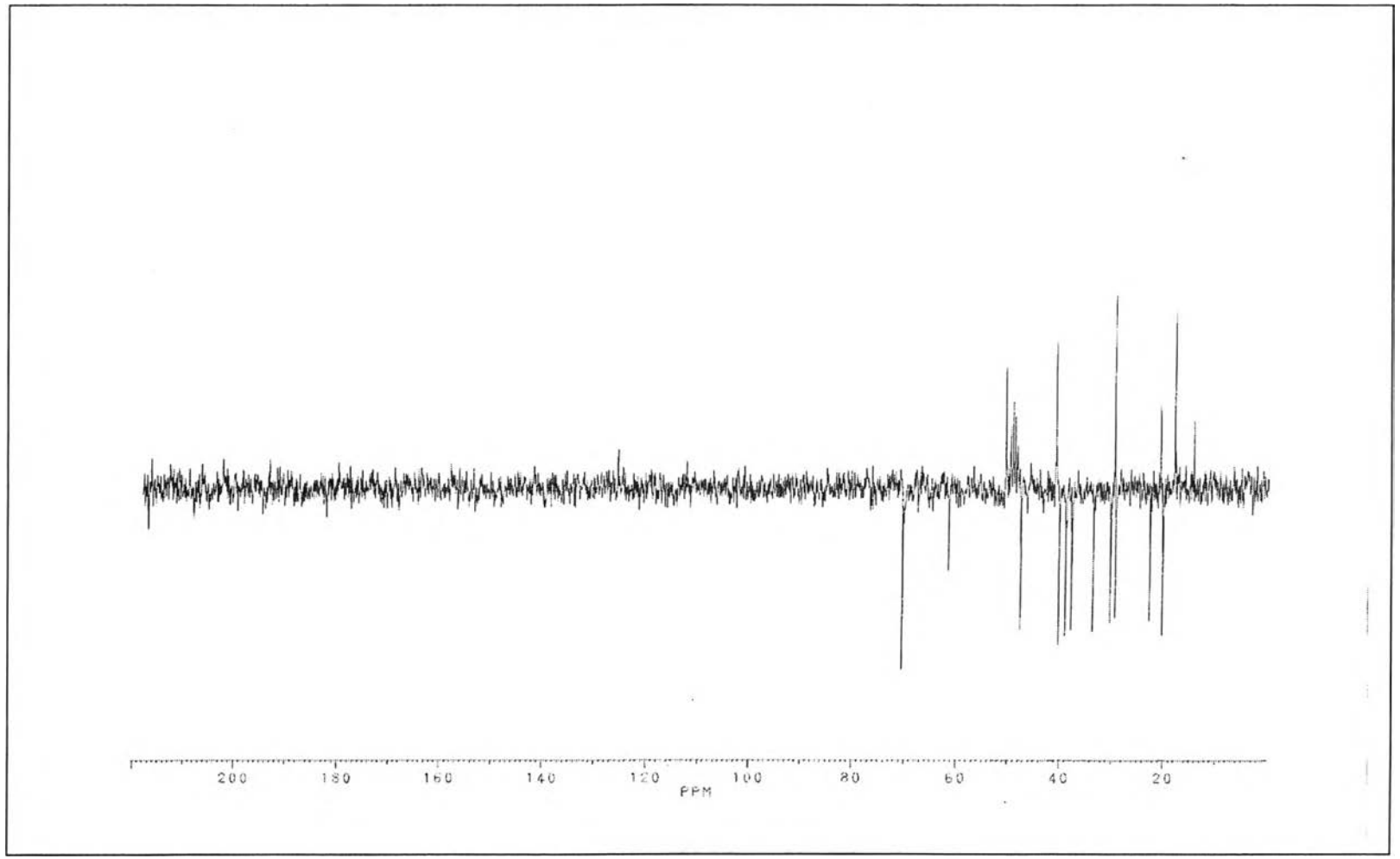

Figure B60. The DEPT spectrum of Metabolite **1f**.

ต้นฉบับ หน้าขาดหาย

ต้นฉบับ หน้าขาดหาย

ต้นฉบับ หน้าขาดหาย

ต้นฉบับ หน้าขาดหาย

ต้นฉบับ หน้าขาดหาย

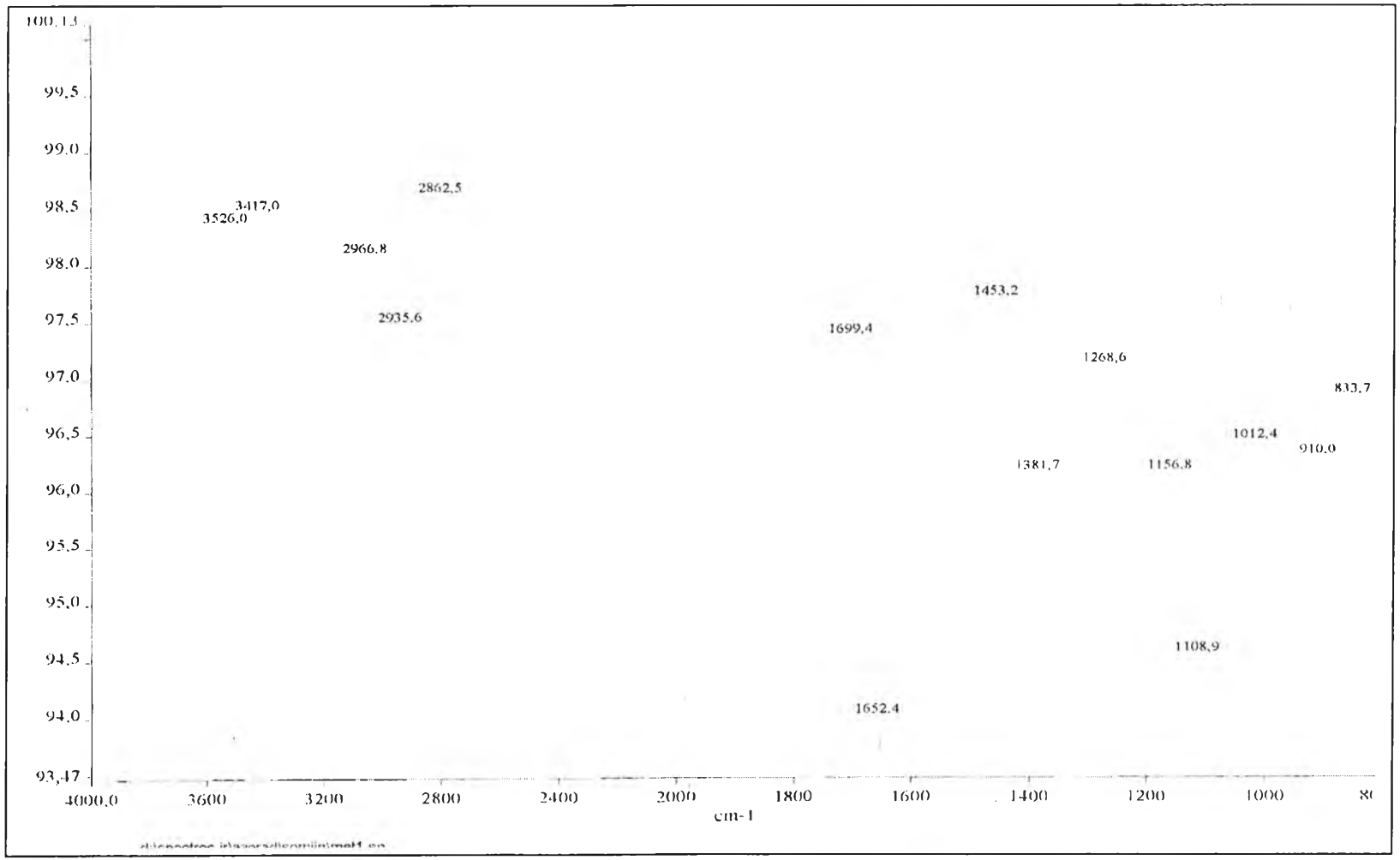

Figure B66. The IR spectrum of Metabolite **2a**.

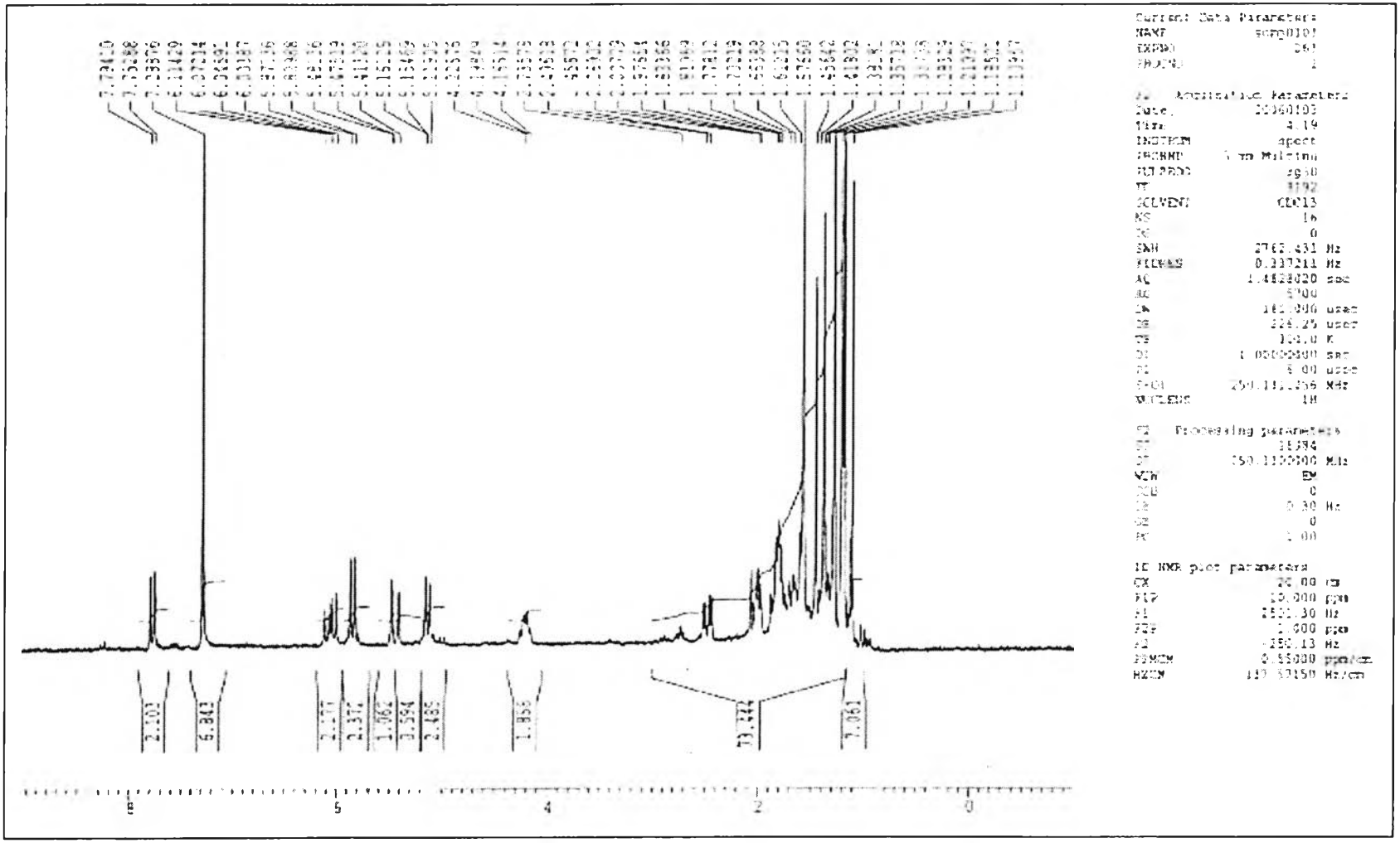

Figure B67. The ^{1}H-NMR spectrum of Metabolite **2a**.

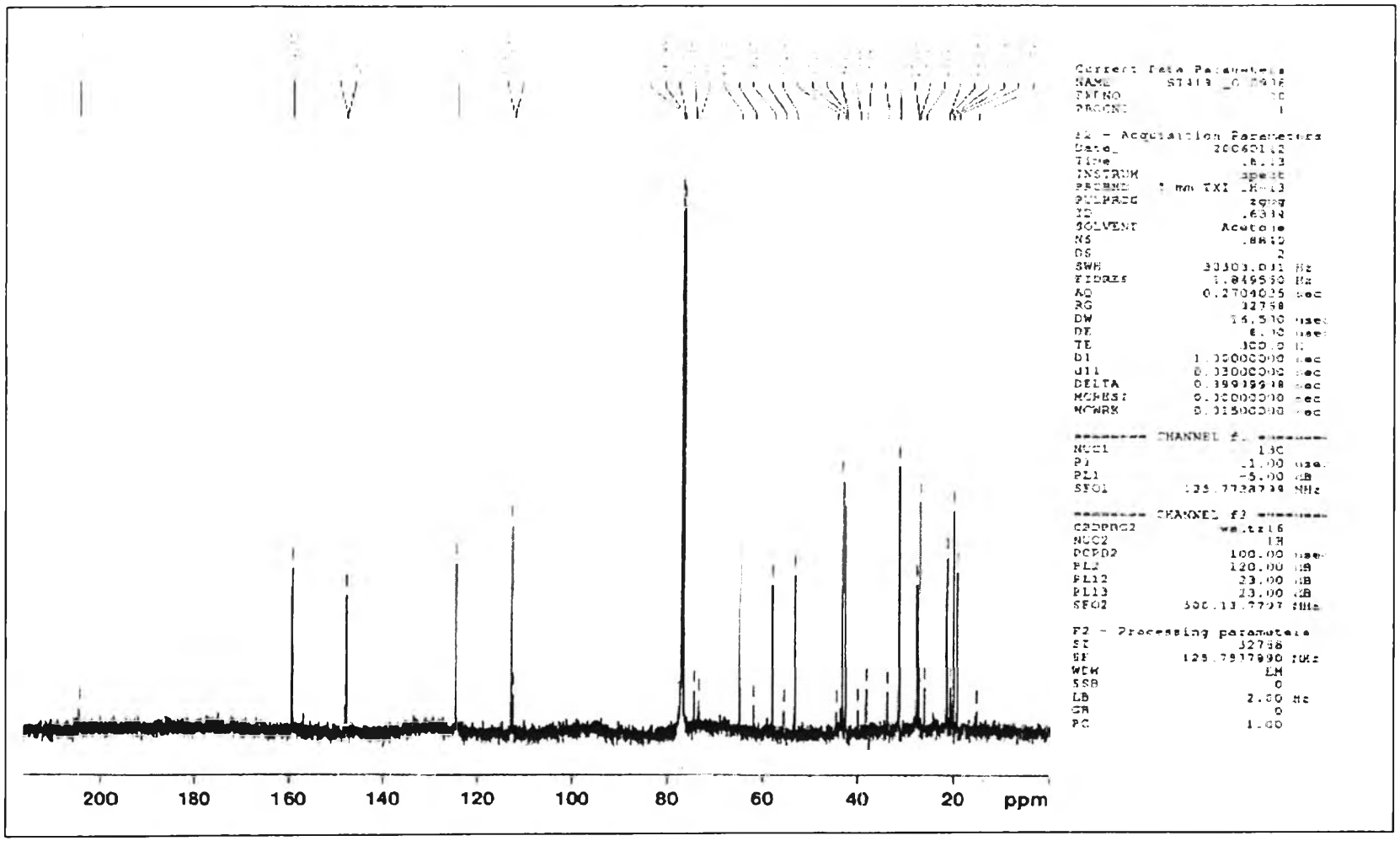

Figure B68. The ^{13}C-NMR spectrum of Metabolite **2a**.

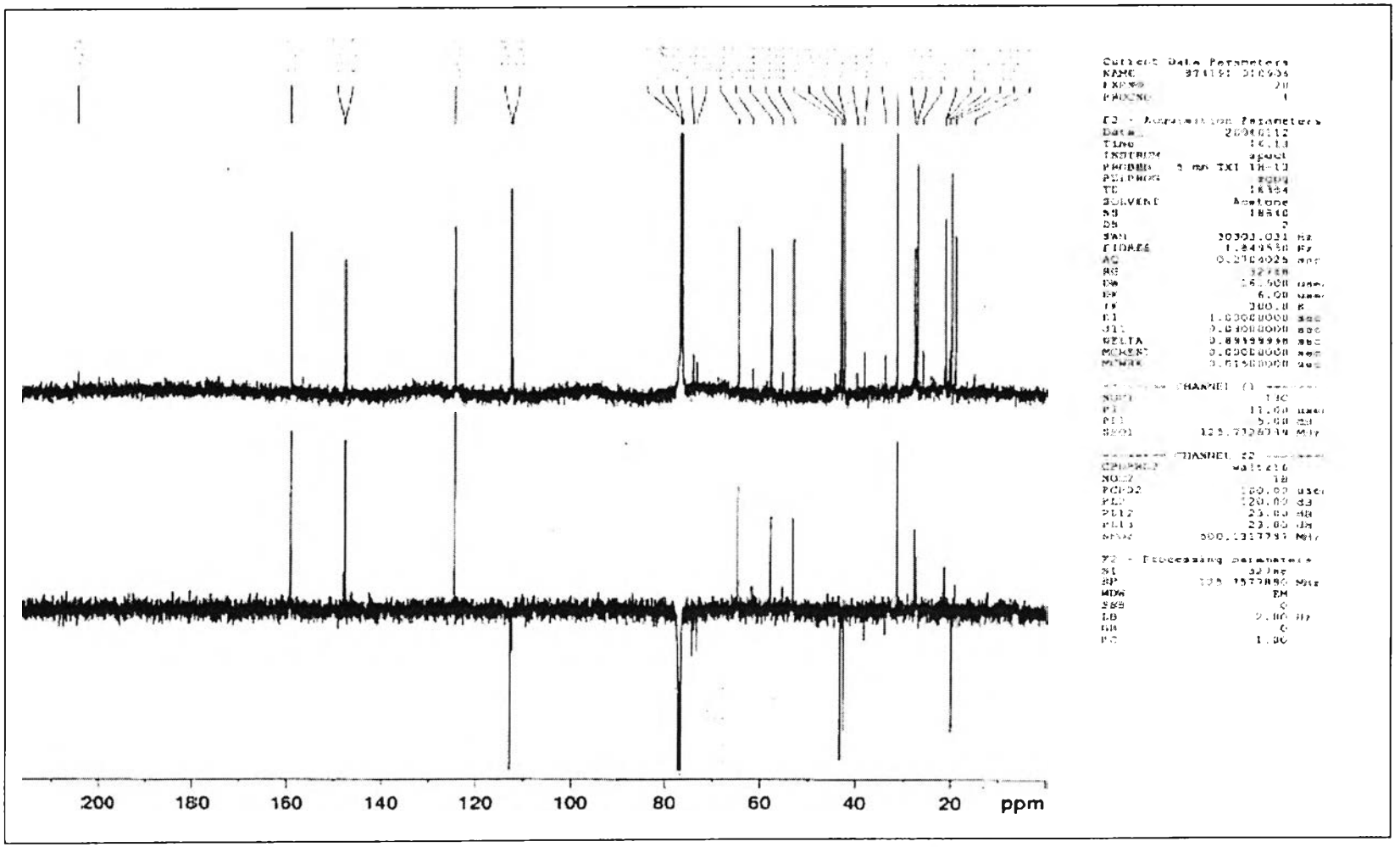

Figure B69. The DEPT spectrum of Metabolite **2a**.

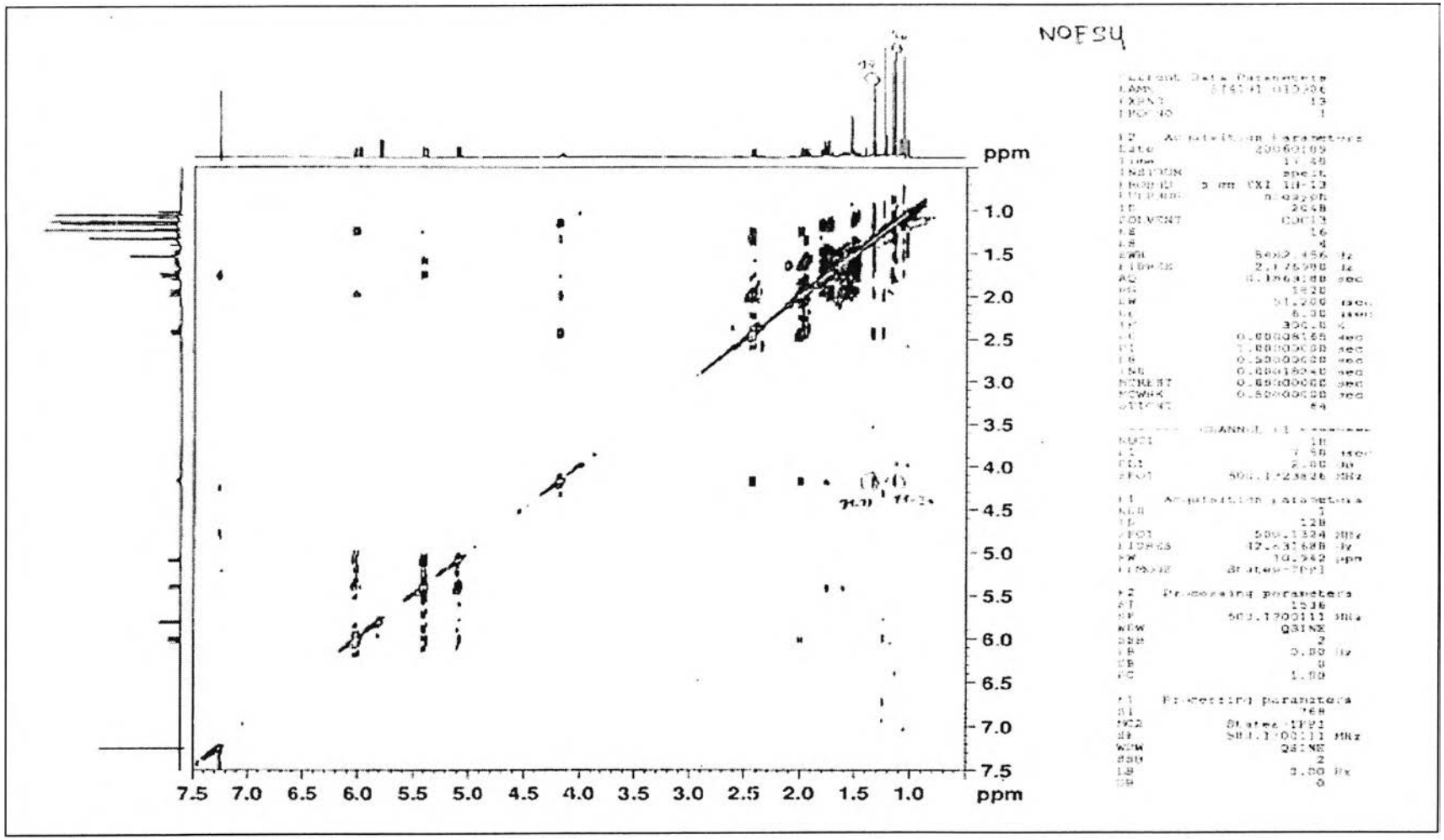

Figure B70. The gNOESY spectrum of Metabolite **2a**.

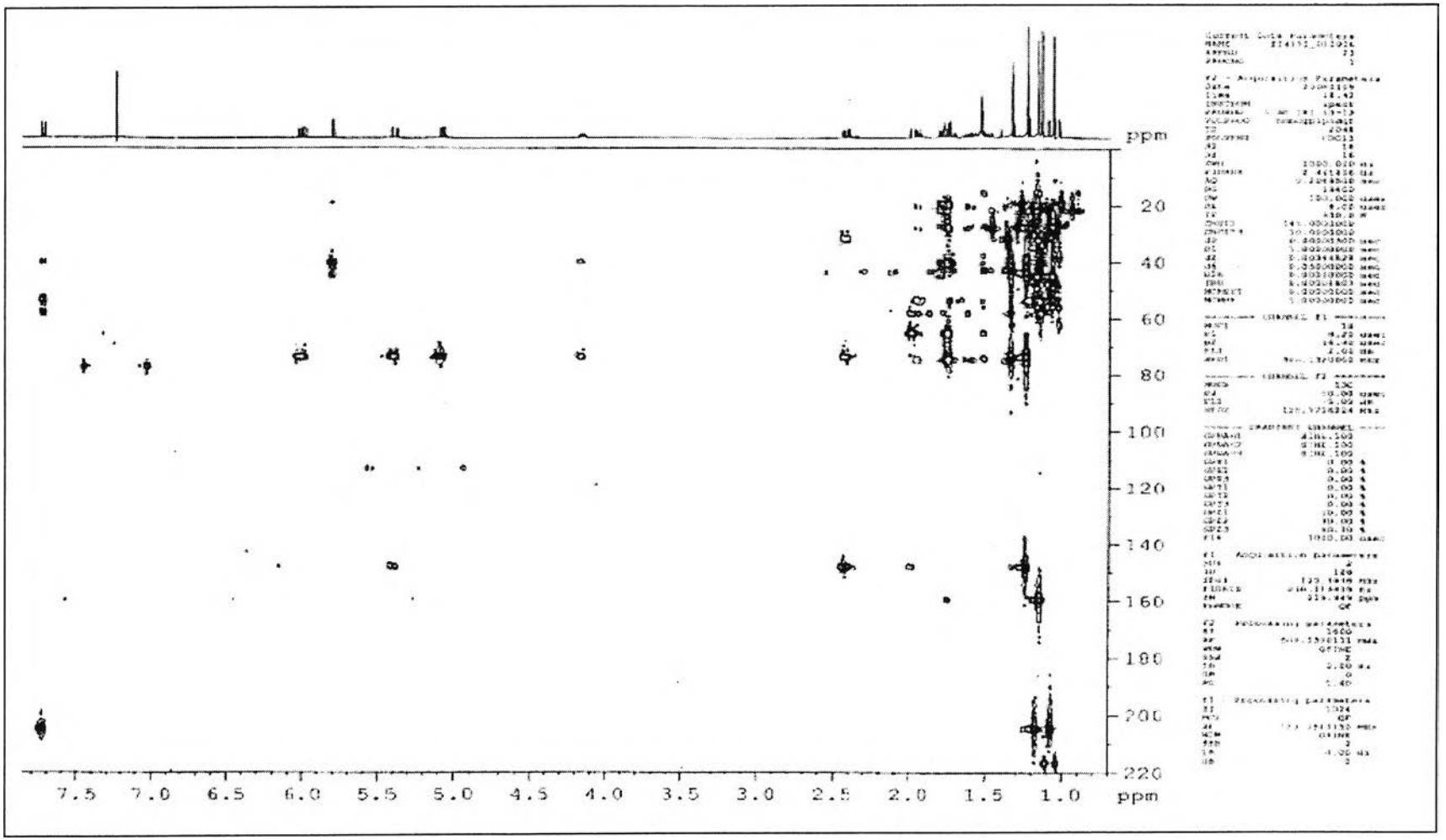

Figure B71. The gHMBC spectrum of Metabolite **2a**.

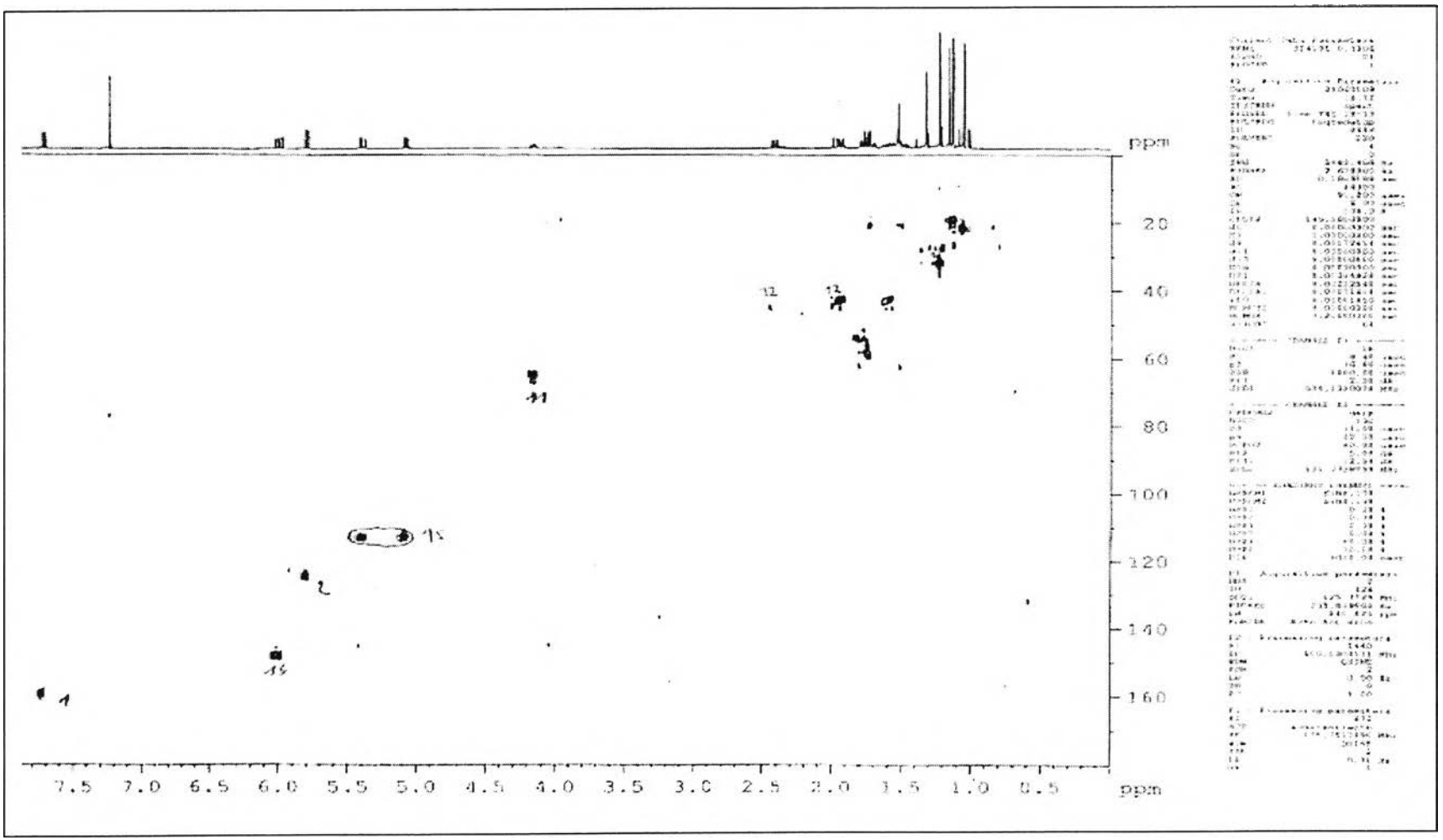

Figure B72. The gHSQC spectrum of Metabolite **2a**.

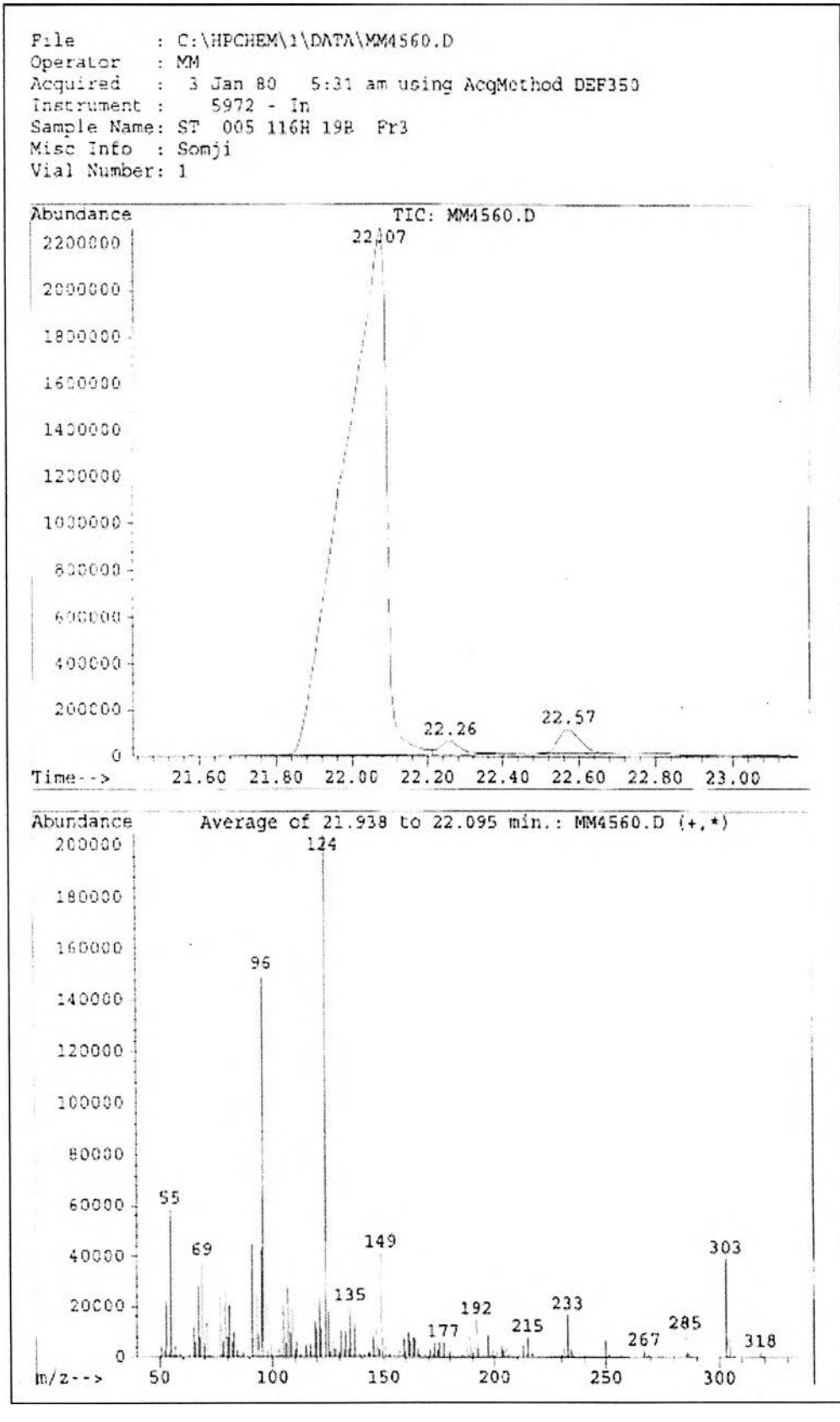

Figure B73. The GC-MS spectrum of Metabolite **2a**.

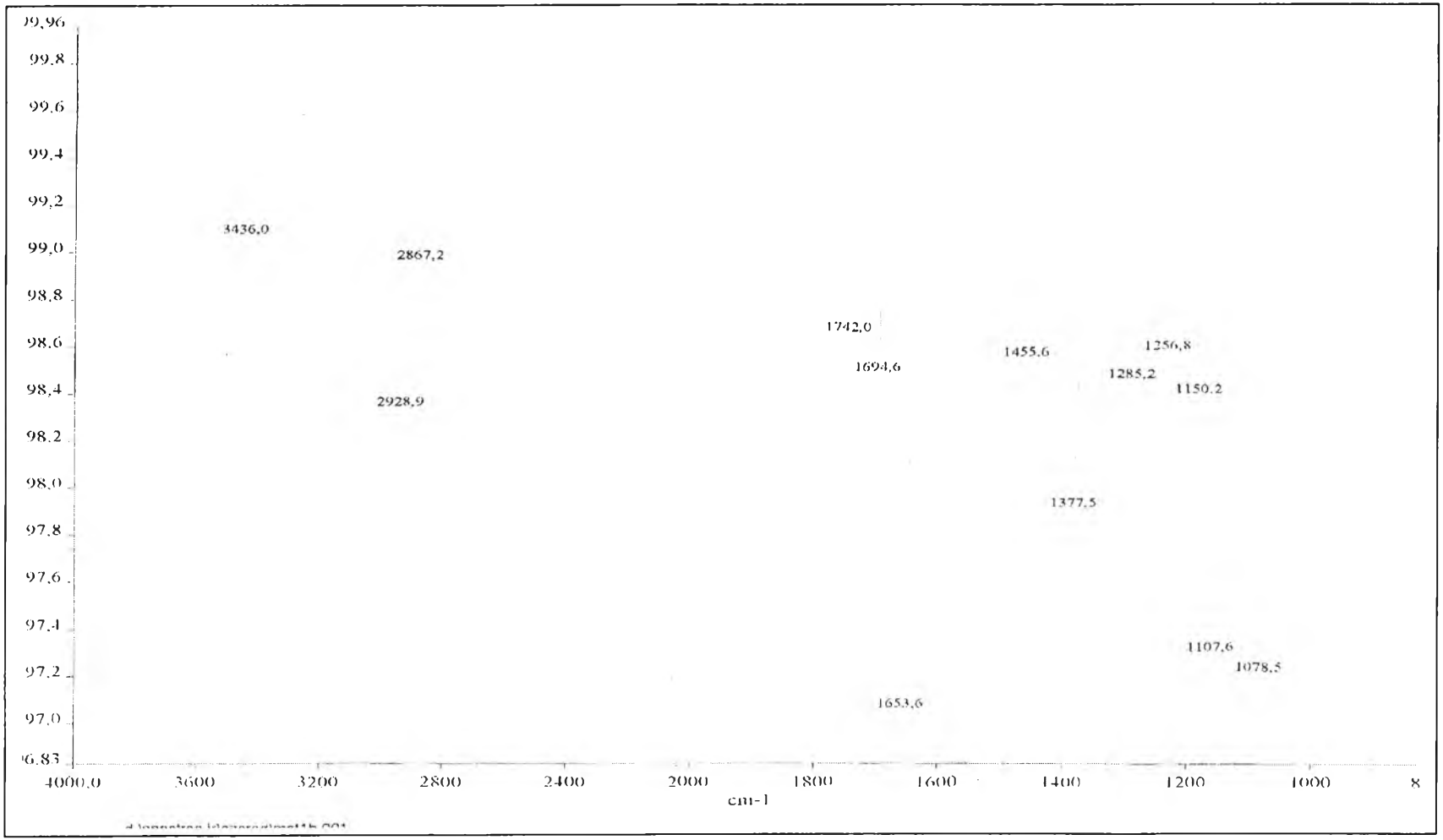

Figure B74. The IR spectrum of Metabolite **2b**.

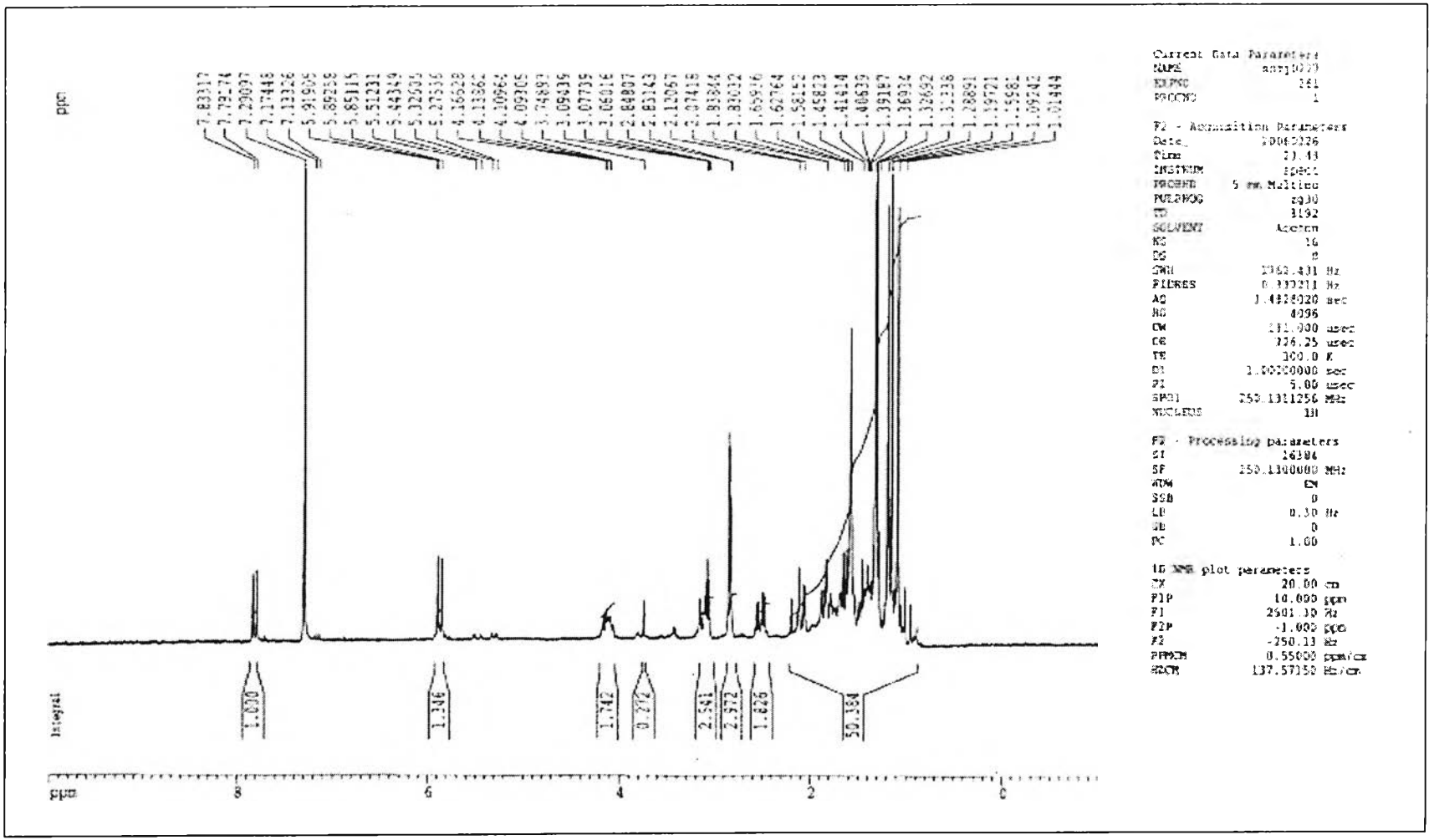

Figure B75. The ^{1}H-NMR spectrum of Metabolite **2b**.

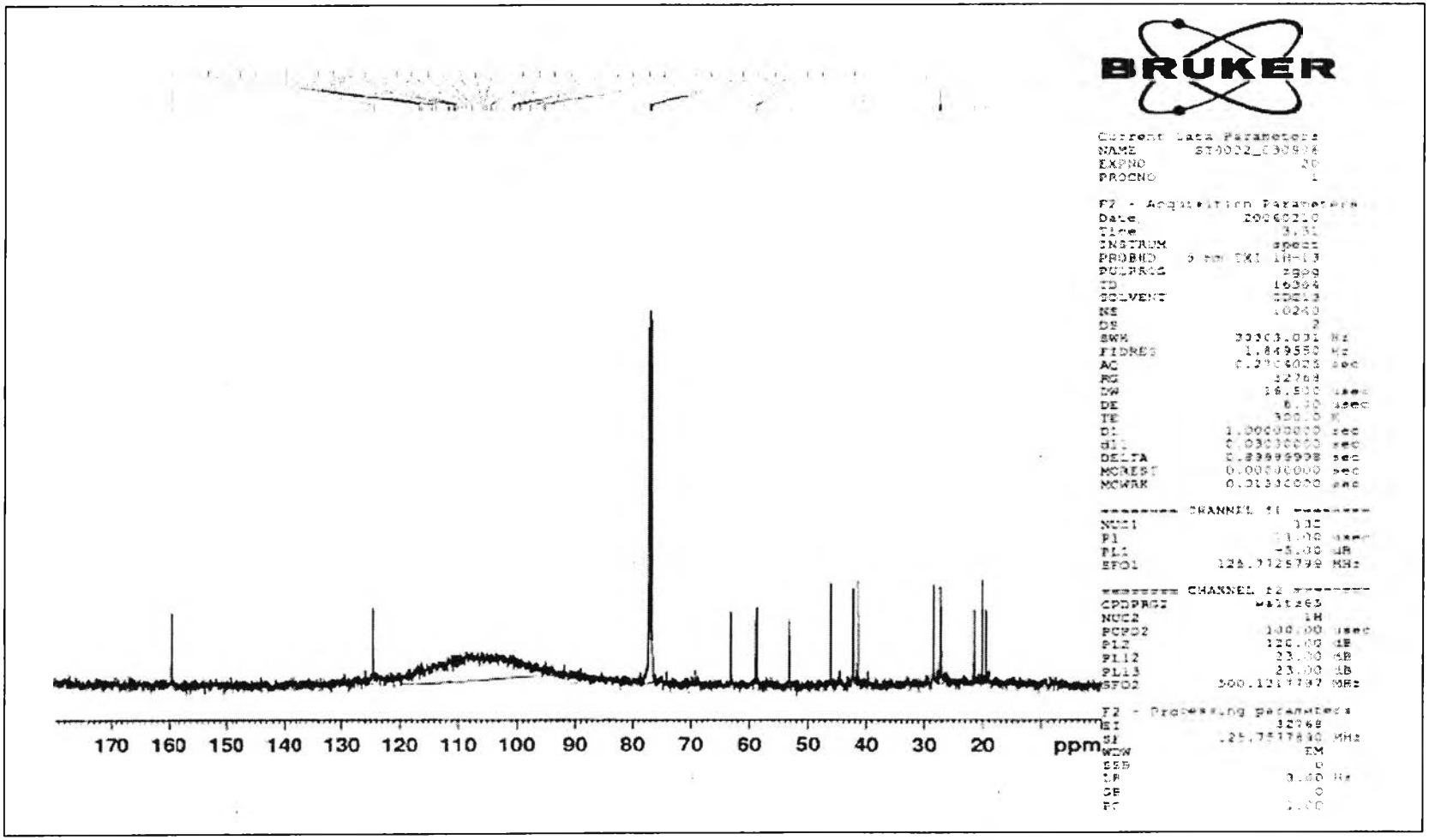

Figure B76. The ^{13}C-NMR spectrum of Metabolite **2b**.

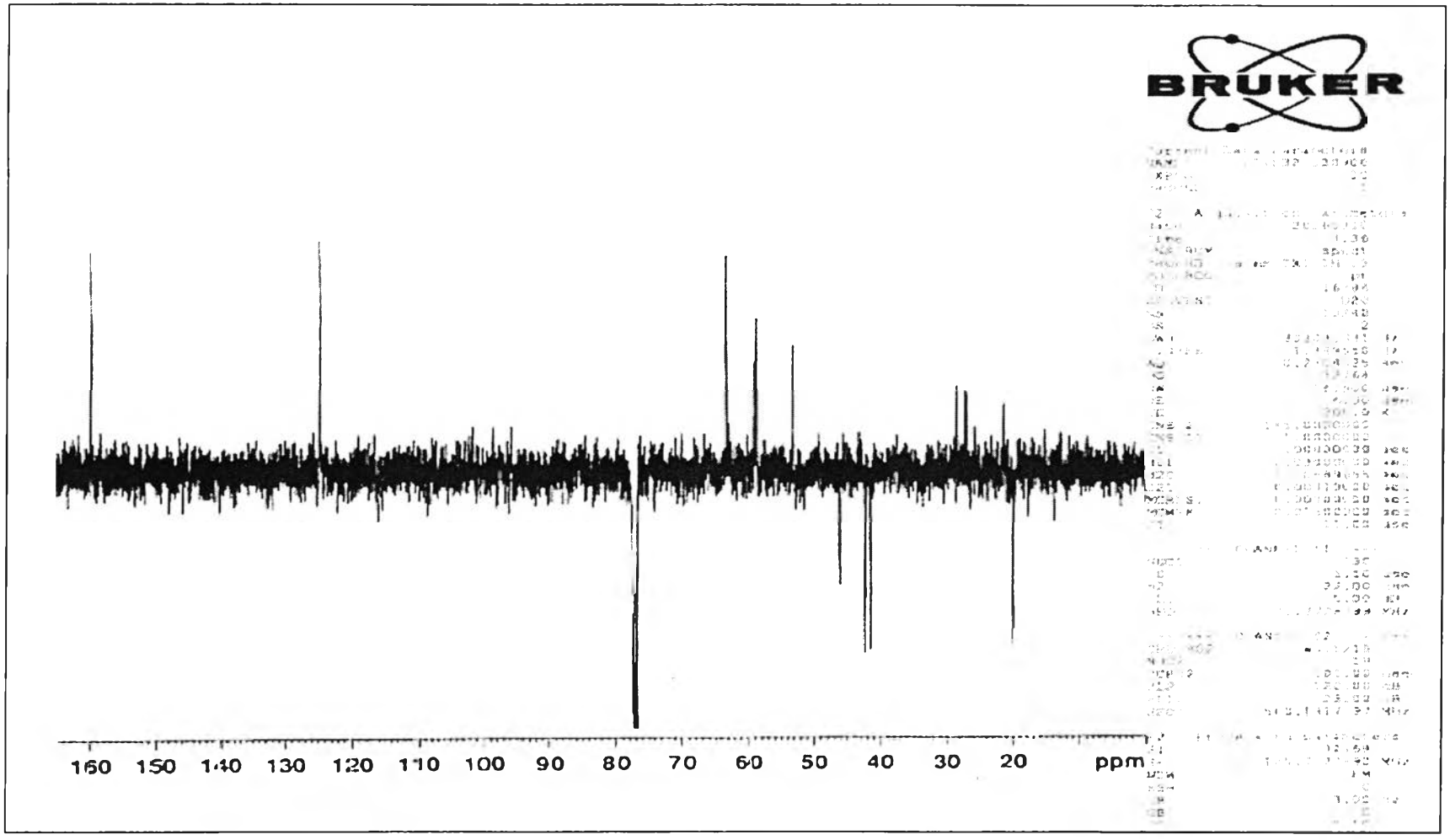

Figure B77. The DEPT spectrum of Metabolite **2b**.

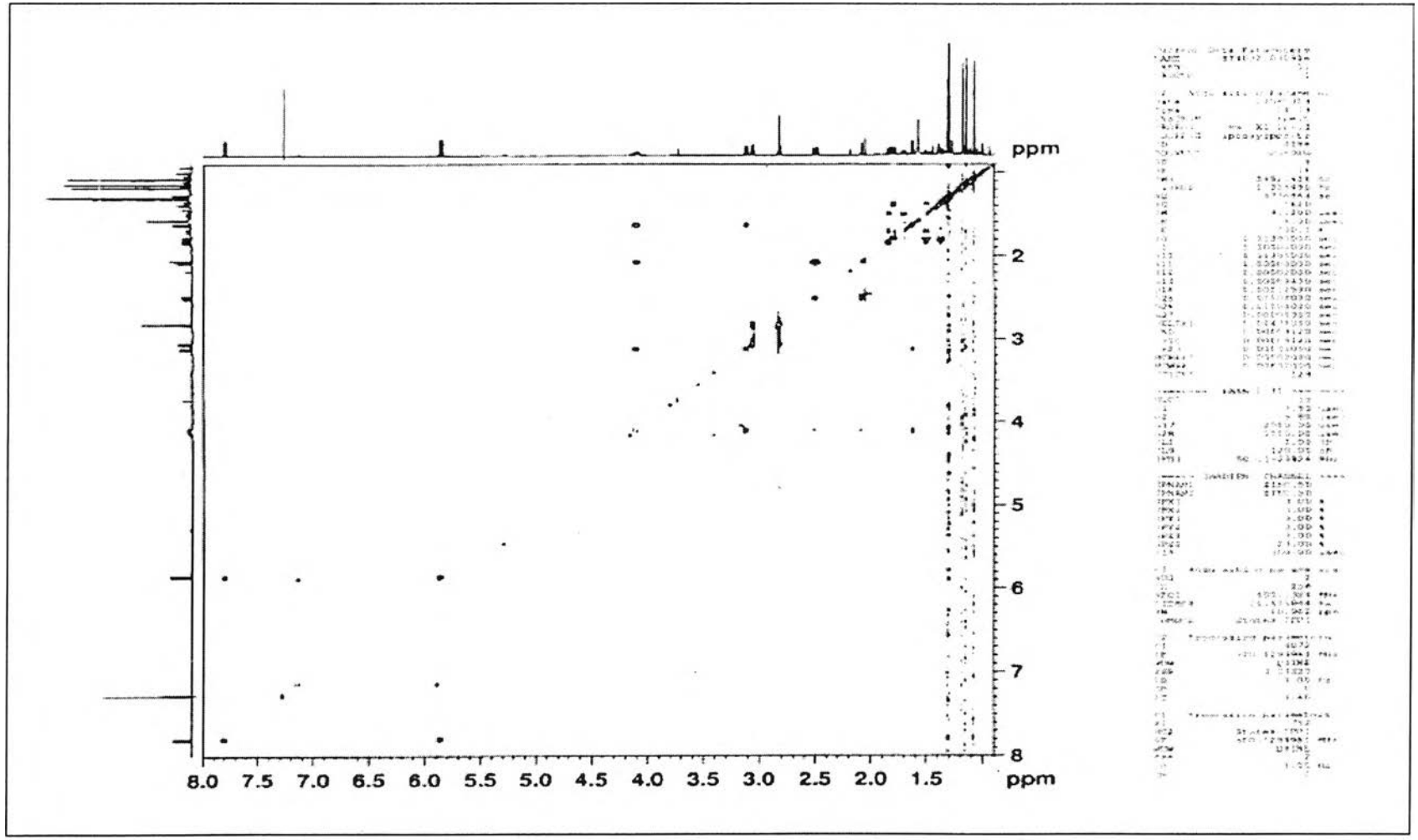

Figure B78. The gCOSY spectrum of Metabolite **1b**.

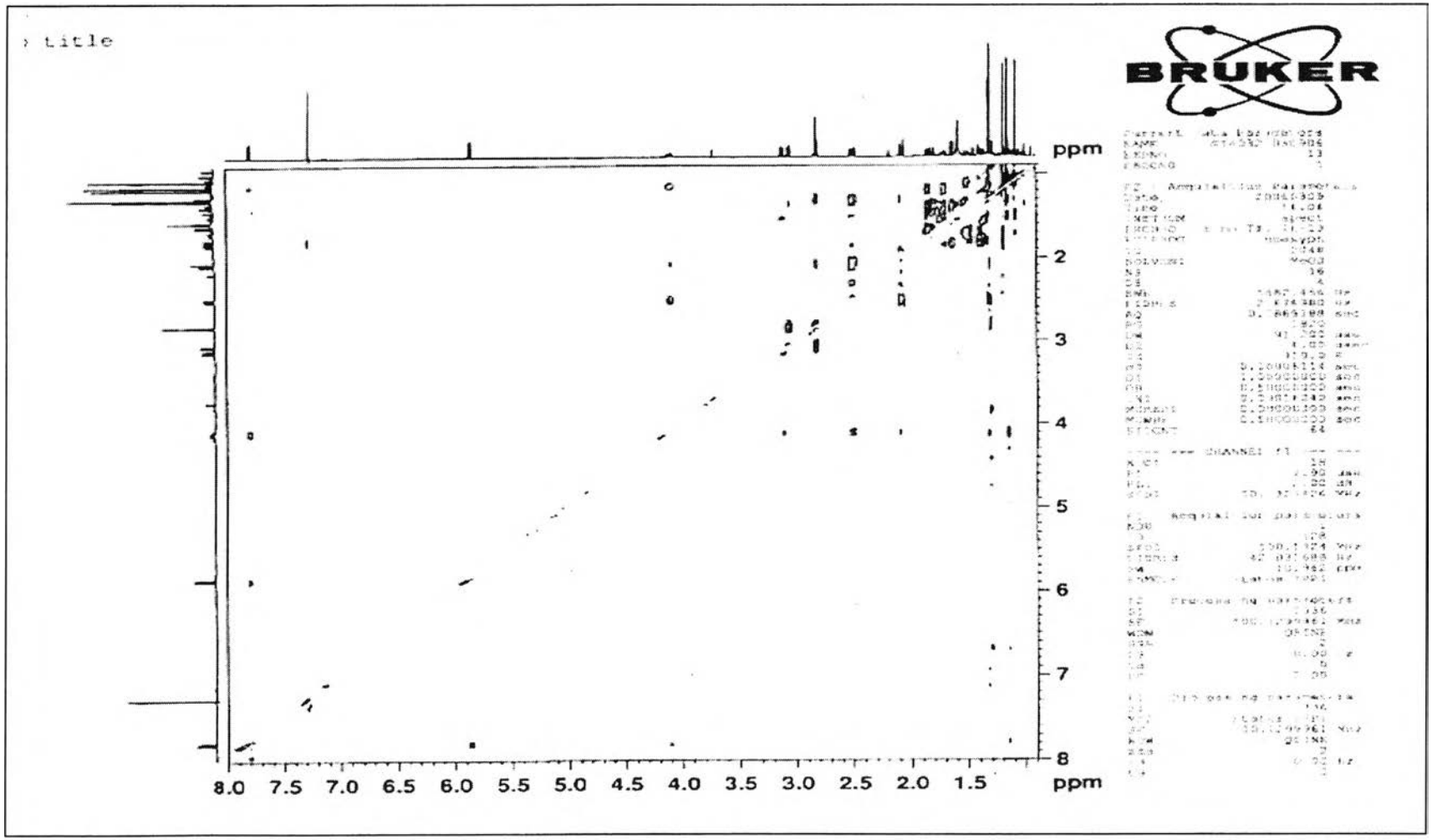

Figure B79. The gNOESY spectrum of Metabolite **2b**.

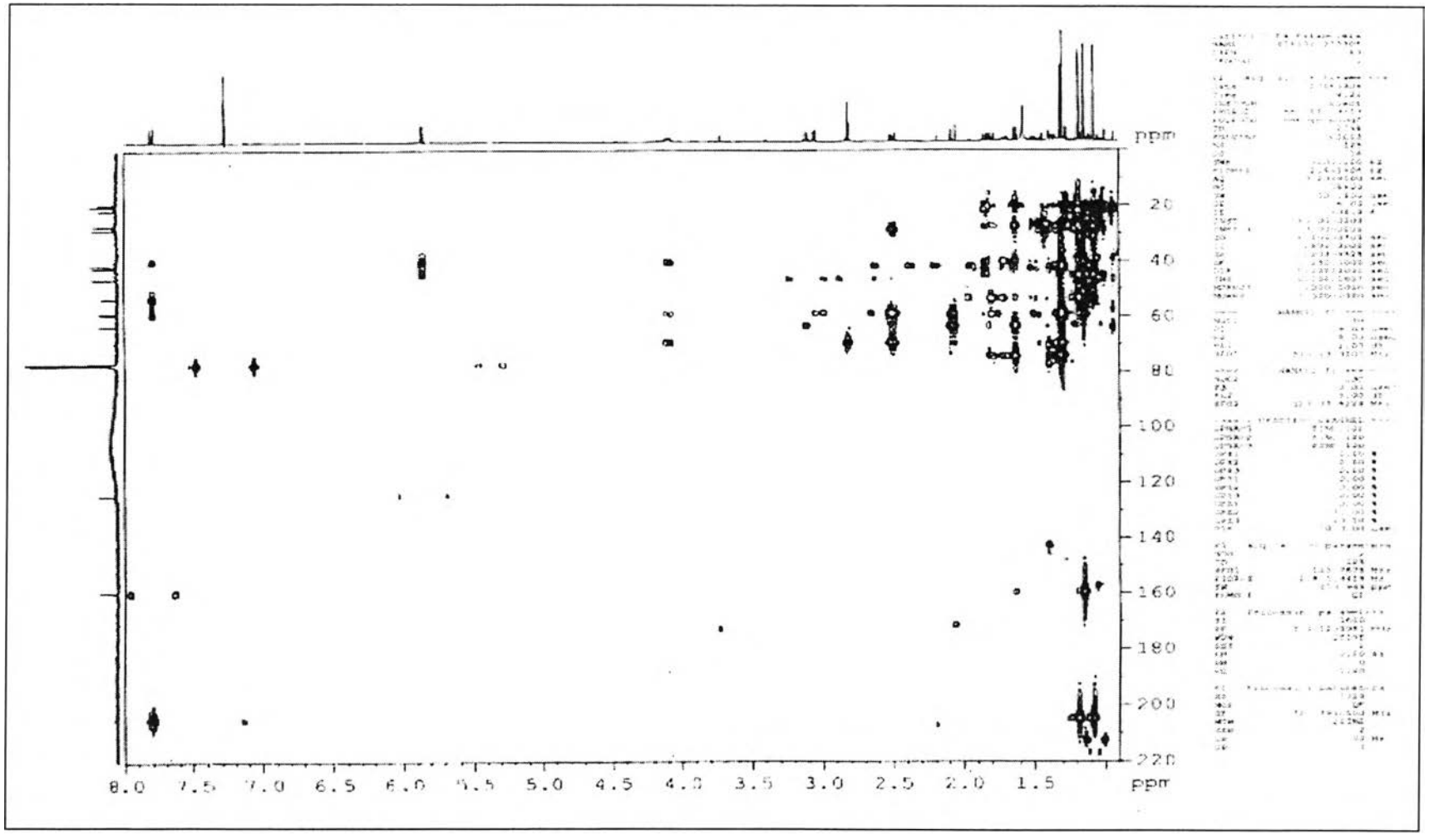

Figure B80. The gHMBC spectrum of Metabolite **2b**.

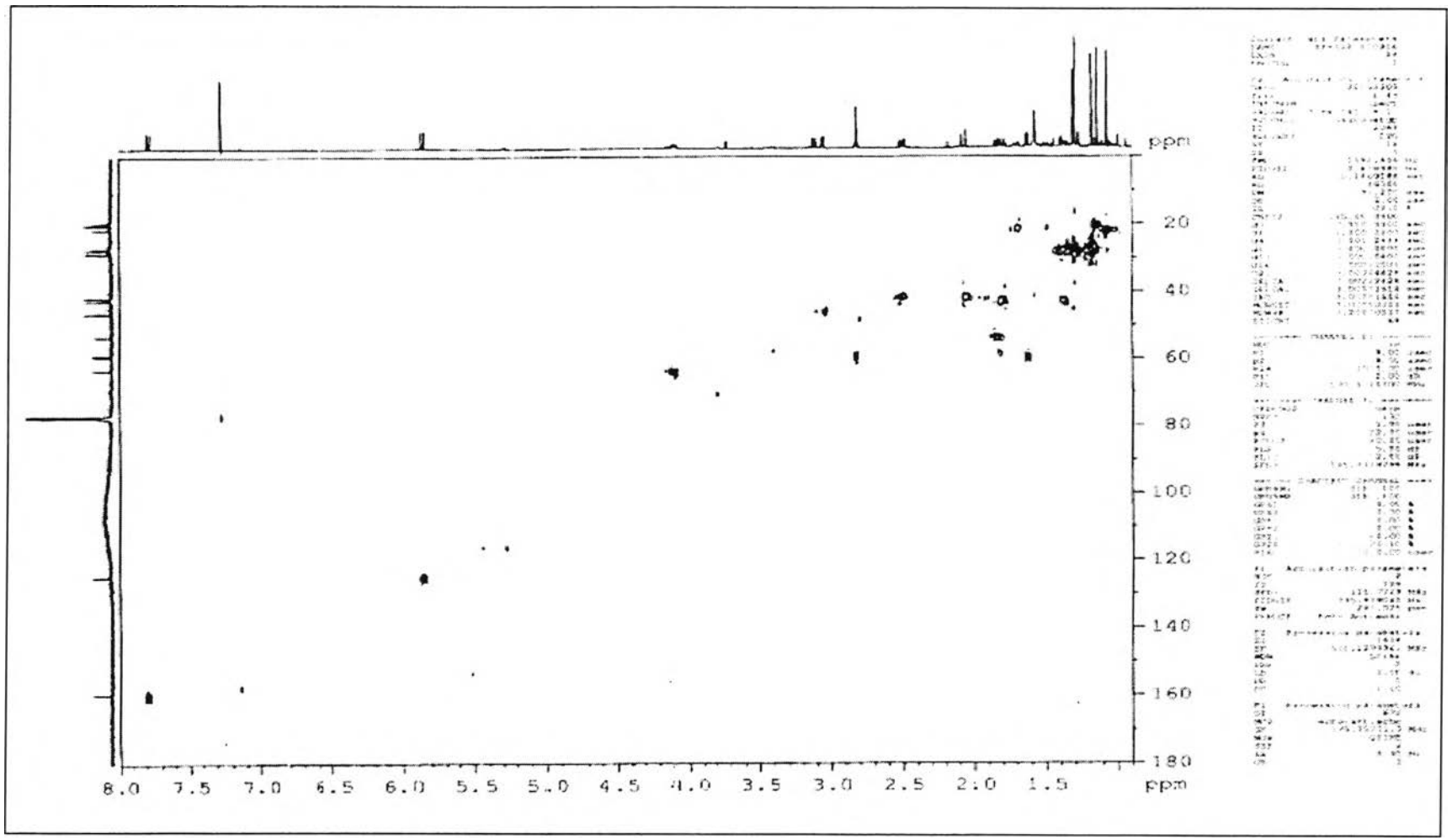

Figure B81. The gHSQC spectrum of Metabolite **2b**.

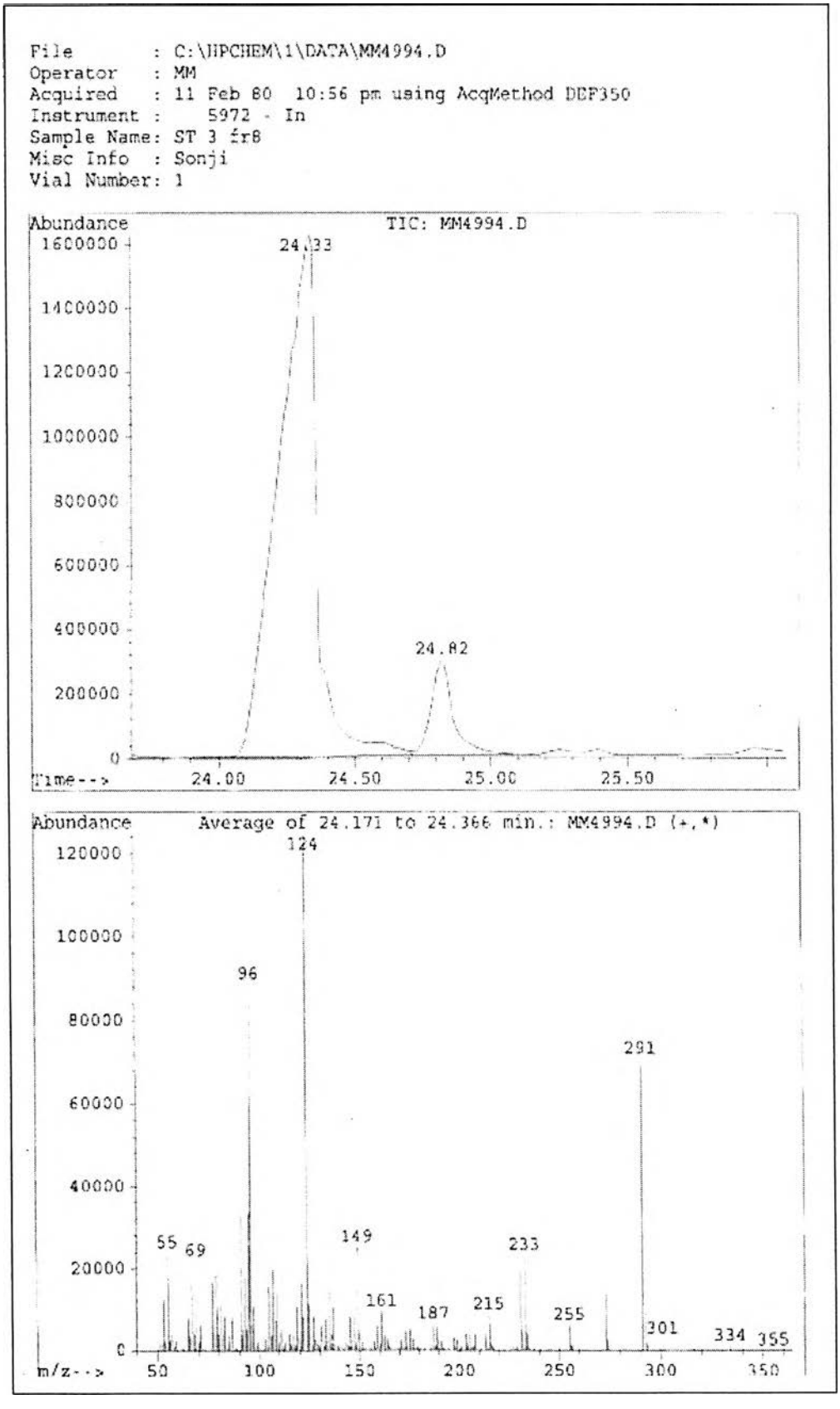

Figure B82. The GC-MS spectrum of Metabolite **2b**.

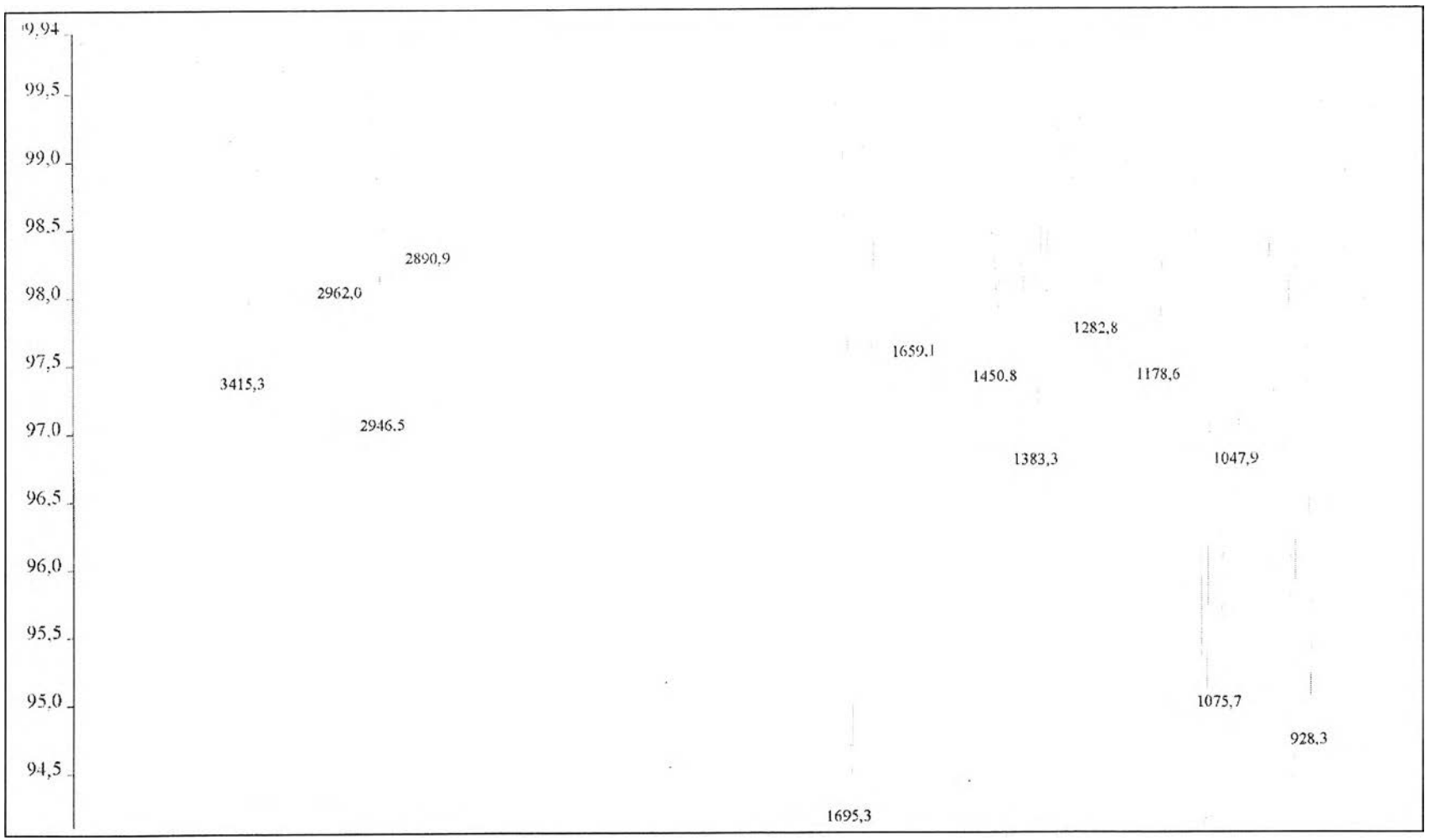

Figure B83. The IR spectrum of Metabolite **2c**.

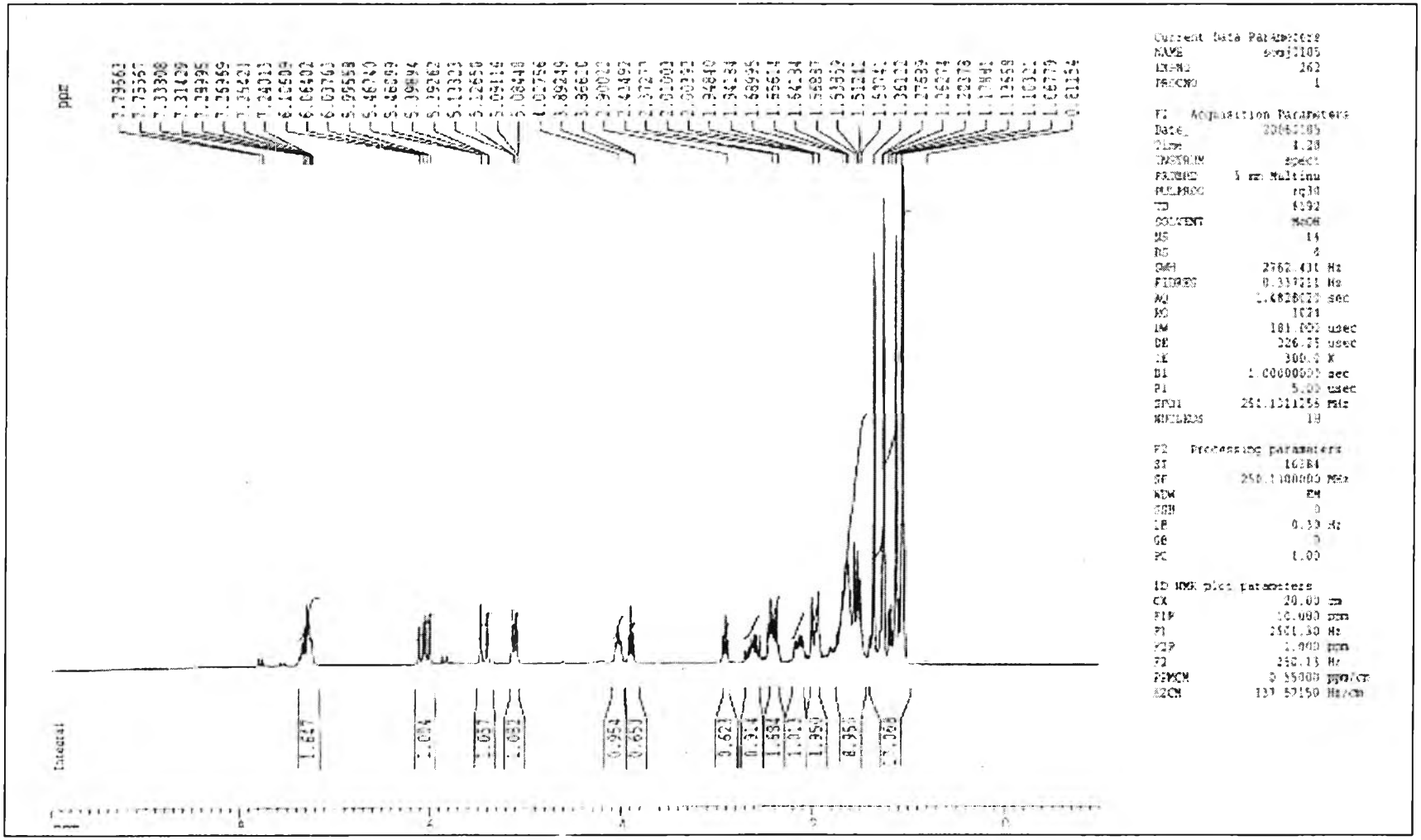

Figure B84. The ^{1}H-NMR spectrum of Metabolite **2c**.

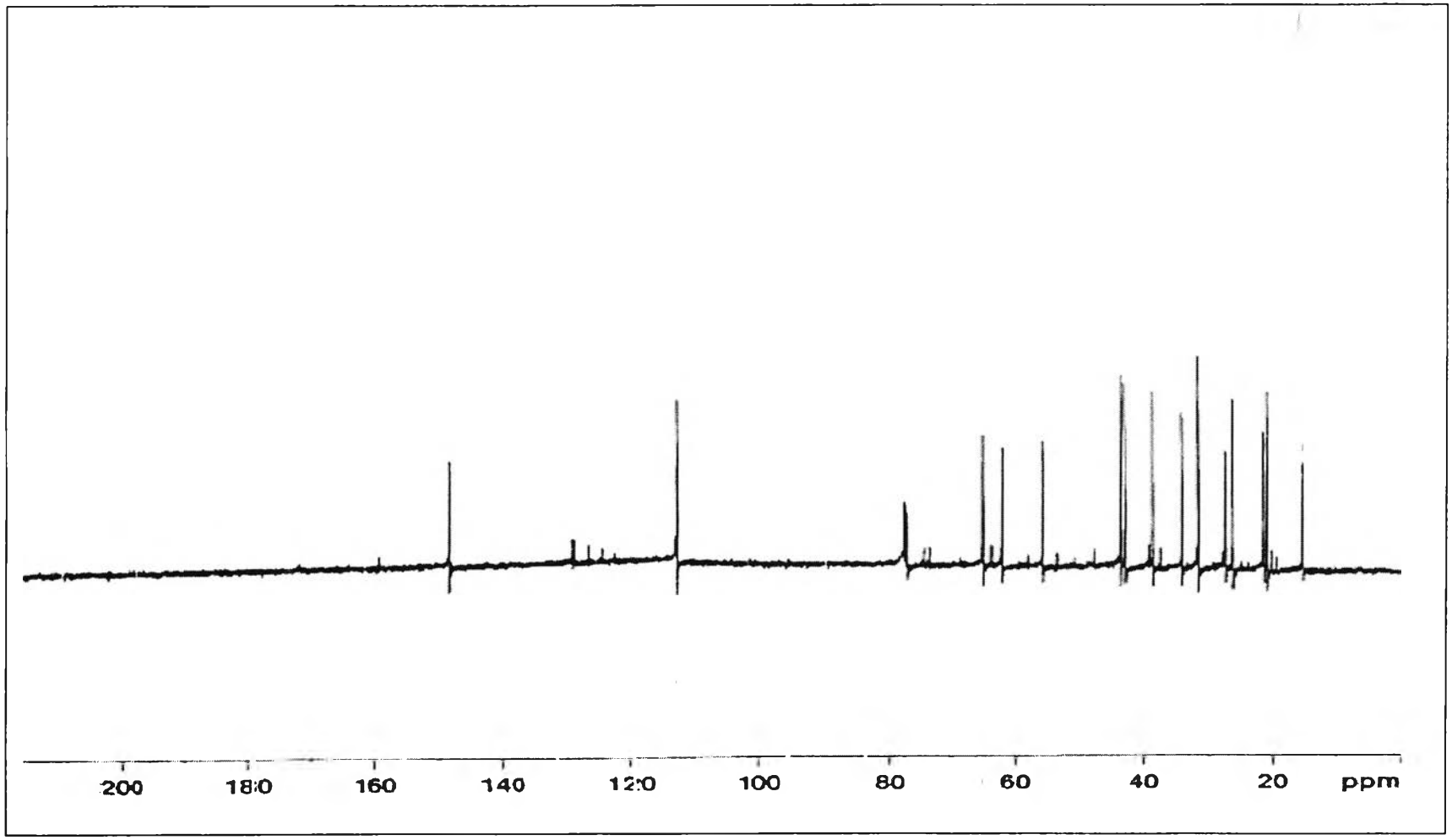

Figure B85. The ^{13}C-NMR spectrum of Metabolite **2c**.

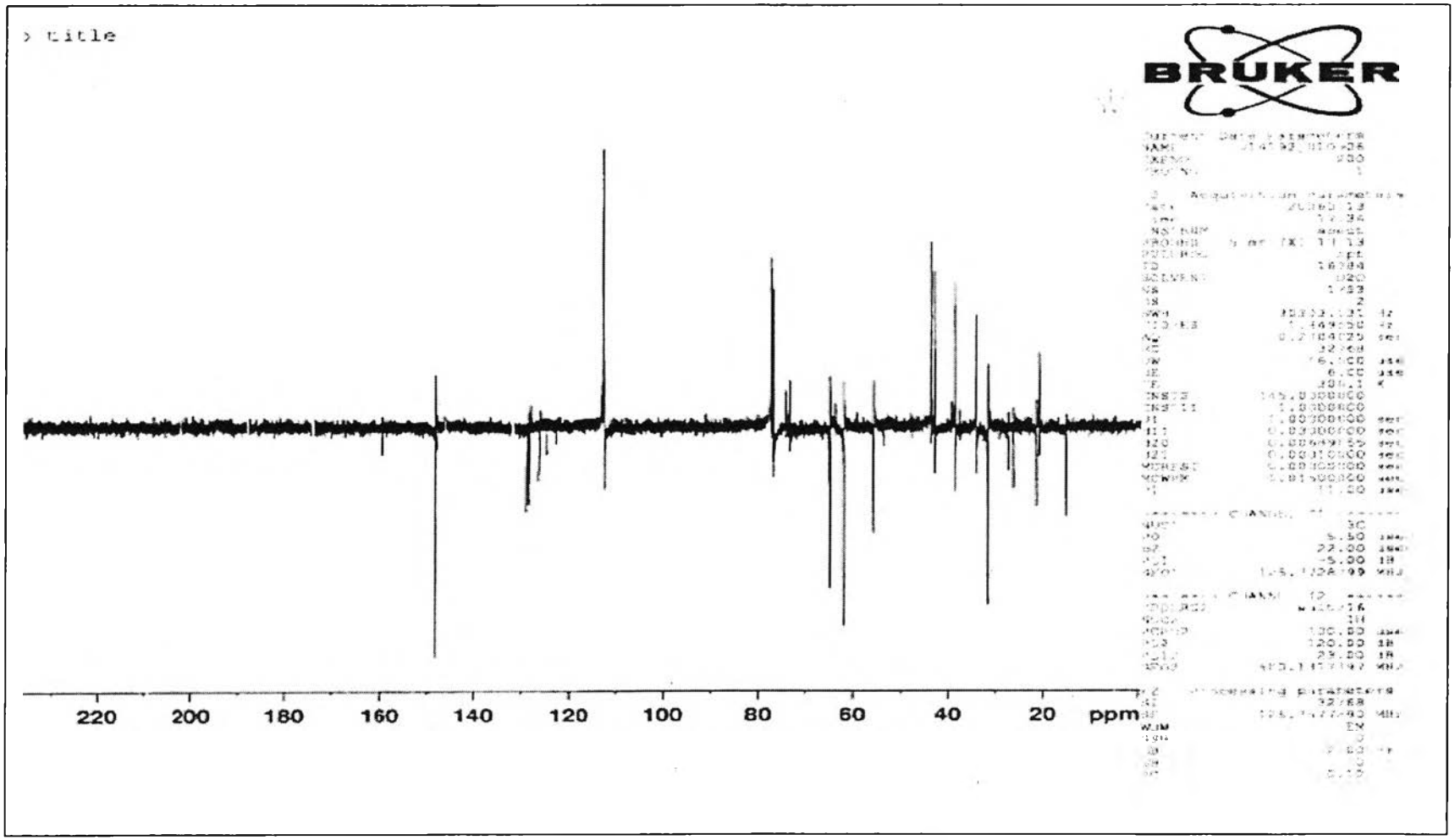

Figure B86. The DEPT spectrum of Metabolite **2c**.

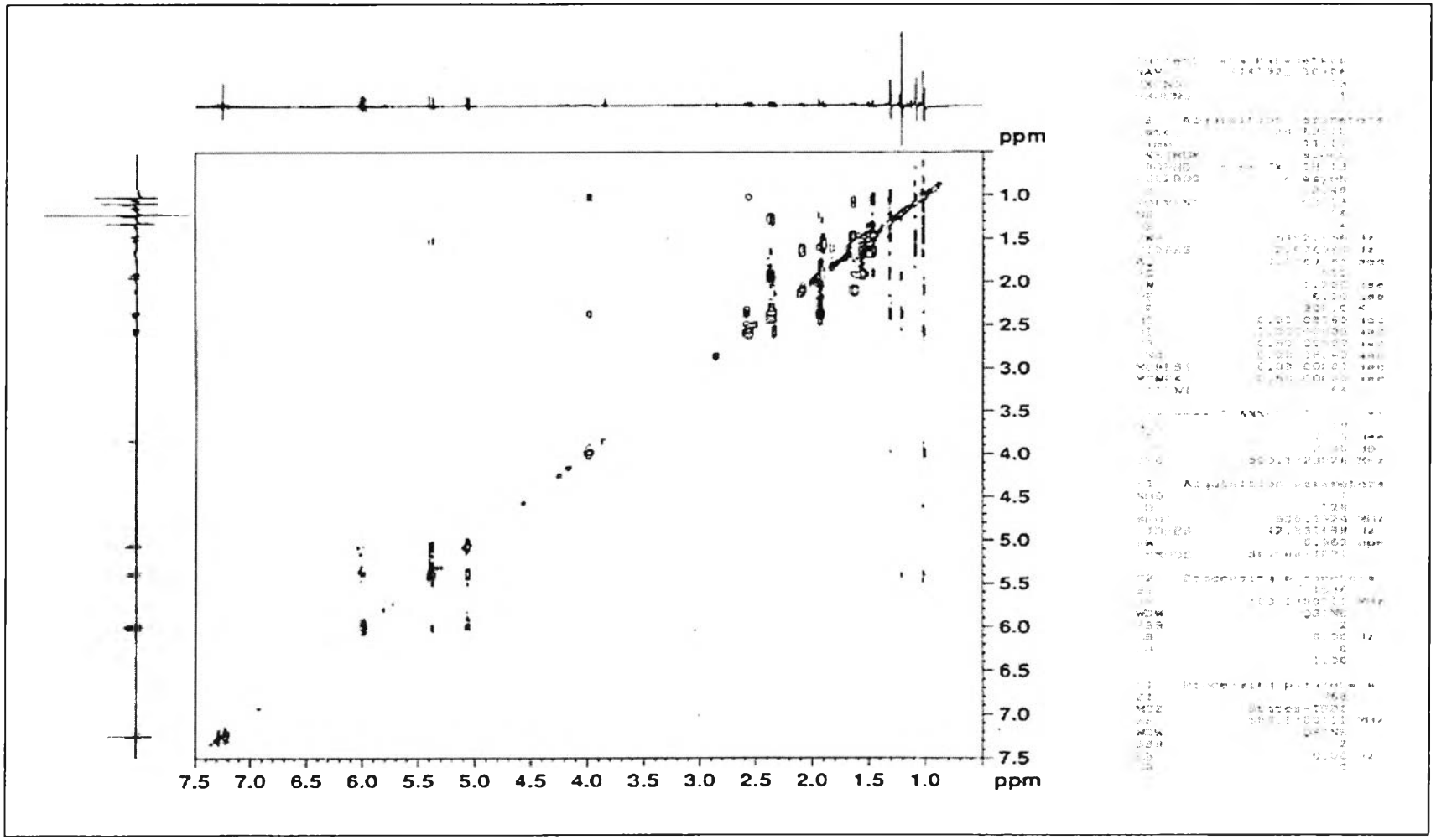

Figure B87. The gNOESY spectrum of Metabolite **2c**.

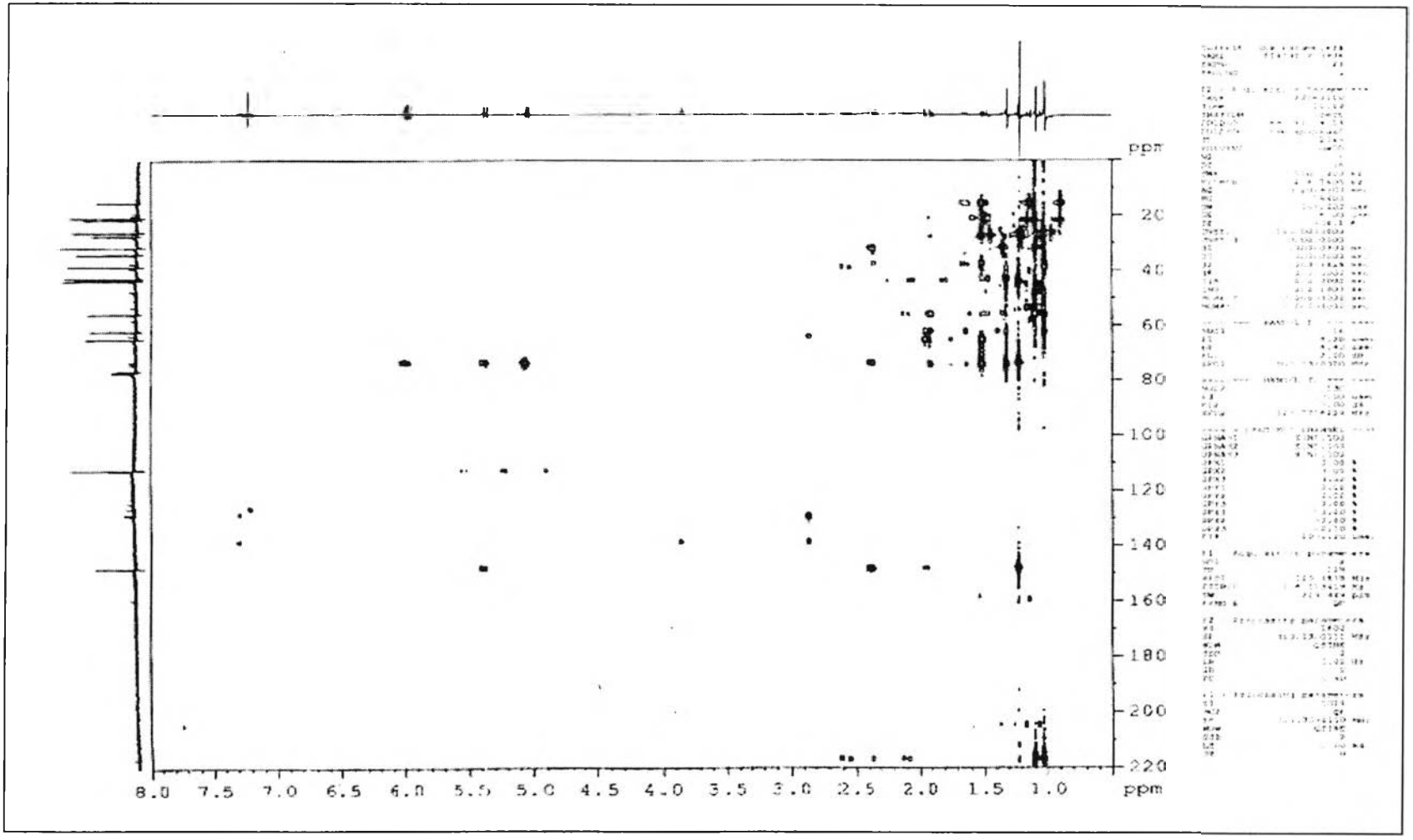

Figure B88. The gHMBC spectrum of Metabolite **2c**.

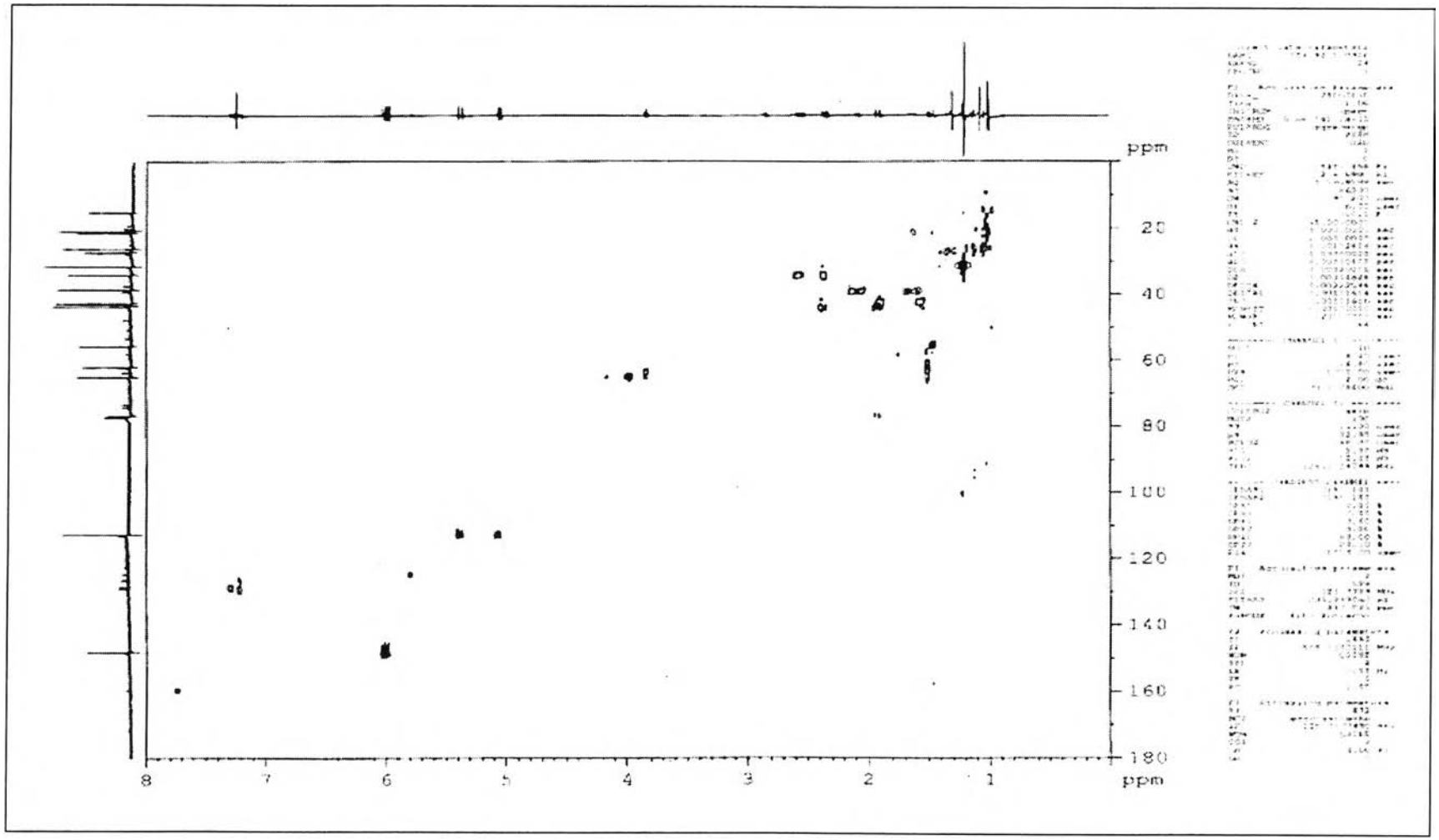

Figure B89. The gHSQC spectrum of Metabolite **2c**.

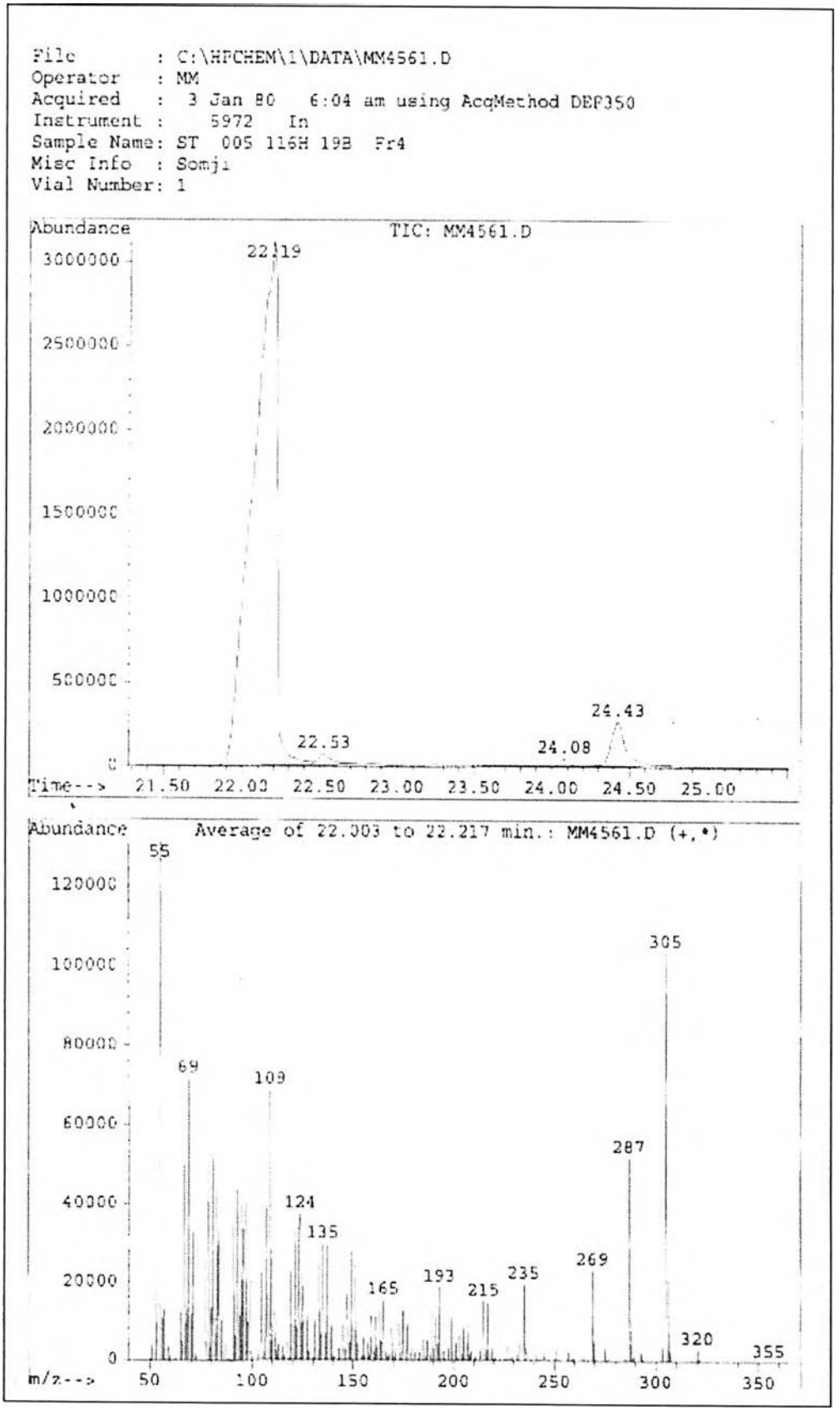

Figure B90. The GC-MS spectrum of Metabolite **2c**.

APPENDIX C

Table C1. Crystal data and structure refinement for metabolite 1c.

Empirical formula	$C_{20} H_{30} O_4$	
Formula weight	334.44	
Temperature	293(2) K	
Wavelength	0.71073 Å	
Crystal system, space group	orthorhombic, $P2_{(1)} 2_{(1)} 2_{(1)}$	
Unit cell dimensions	a = 7.8825(10) Å	alpha = 90 deg.
	b = 11.1507(15) Å	beta = 90 deg.
	c = 21.621(3) Å	gamma = 90 deg.
Volume	1900.4(4) $Å^3$	
Z, Calculated density	4, 1.169 Mg/m^3	
Absorption coefficient	0.080 mm^{-1}	
F(000)	728	
Theta range for data collection	2.05 to 26.37 deg.	
Index ranges	$-9 \leq h \leq 9, -13 \leq k \leq 13, -27 \leq l \leq 26$	
Reflections collected / unique	15283 / 3877 [R(int) = 0.0202]	
Completeness to theta	26.37 100.0%	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	3877/ 0 / 330	
Goodness-of-fit on F^2	1.056	
Final R indices [I > 2sigma(I)]	R1 = 0.0431, wR2 = 0.1129	
R indices (all data)	R1 = 0.0452, wR2 = 0.1148	
Absolute structure parameter	0.00	
Extinction coefficient	0.0033(15)	
Largest diff. peak and hole	0.285 and -0.244 e. $Å^{-3}$	

Table C2. Bond lengths (Å) for metabolite 1c.

Bond lengths	(Å)
C(1) - C(2)	1.536 (2)
C(1) - C(3)	1.5611 (19)
C(1) - C(9)	1.566 (2)
C(1) - C(13)	1.575 (2)
C(2) - H(21)	1.00 (2)
C(2) - H(22)	0.92 (2)
C(2) - H(23)	0.99 (2)
C(3) - O(1)	1.4355 (19)
C(3) - C(4)	1.519 (2)
C(3) - H(3)	0.985 (17)
C(4) - C(5)	1.506 (3)
C(4) - H(41)	0.93 (2)
C(4) - H(42)	0.92 (2)
C(5) - C(6)	1.530 (2)
C(5) - H(51)	0.99 (2)
C(5) - H(52)	0.96 (2)
C(6) - C(8)	1.526 (2)
C(6) - C(7)	1.544 (2)
C(6) - C(9)	1.558 (2)
C(7) - H(71)	1.02 (2)
C(7) - H(72)	0.98 (2)
C(7) - H(73)	0.93 (2)
C(8) - O(3)	1.214 (2)
C(8) - O(2)	1.297 (2)

Table C2. Bond lengths (Å) for metabolite 1c. (continued)

Bond lengths	(Å)
C(9) - C(10)	1.533 (2)
C(9) - H(9)	0.97 (2)
C(10) - C(11)	1.511 (2)
C(10)- H(101)	1.01 (2)
C(10) - H(102)	0.94 (2)
C(11) - O(4)	1.417 (2)
C(11) - C(12)	1.519 (2)
C(11) - H(11)	0.94 (2)
C(12) - C(17)	1.547 (3)
C(12) - C(18)	1.545 (3)
C(12) - C(13)	1.559 (2)
C(13) - C(14)	1.550 (2)
C(13) - H(13)	0.96 (2)
C(14) - C(15)	1.533 (4)
C(14) - H(141)	0.94 (3)
C(14) - H(142)	0.96 (3)
C(15) - C(16)	1.524 (4)
C(15) - H(151)	1.06 (3)
C(15) - H(152)	0.95 (3)
C(16) - C(19)	1.511 (5)
C(16) - C(17)	1.517 (4)
C(16) - H(16)	1.04 (3)
C(17) - H(171)	0.92 (2)
C(17) - H(172)	0.92 (2)

Table C2. Bond lengths (Å) for metabolite 1c. (continued)

Bond lengths	(Å)
C(18) - C(19)	1.516 (4)
C(18) - H(181)	0.93 (3)
C(18) - H(182)	0.97 (3)
C(19)- C(20)	1.318 (4)
C(20) - H(20A)	0.93 (2)
C(20) - H(20B)	0.93 (2)
O(1) - H(1)	0.72 (2)
O(2) - H(2)	0.87 (3)
O(4) - H(4)	0.76 (2)

Table C3. Bond angles (deg.) for metabolite 1c.

Angles	(deg.)	Angles	(deg.)
C(2) - C(1) - C(3)	108.48 (12)	C(4) - C(5) - C(6)	114.01 (14)
C(2) - C(1) - C(9)	112.79 (12)	C(4) - C(5) - H(51)	109.50 (12)
C(3) - C(1) - C(9)	105.90 (12)	C(6) - C(5) - H(51)	112.90 (11)
C(2) - C(1) - C(13)	114.35 (13)	C(4) - C(5) - H(52)	109.10 (12)
C(3) - C(1) - C(13)	108.72 (12)	C(6) - C(5) - H(52)	103.90 (13)
C(9) - C(1) - C(13)	106.21 (11)	H(51) - C(5) - H(52)	107.00 (16)
C(1) - C(2) - H(21)	112.10 (14)	C(8) - C(6) - C(5)	113.22 (13)
C(1) - C(2) - H(22)	111.80 (14)	C(8) - C(6) - C(7)	105.00 (15)
H(21) - C(2) - H(22)	107.50 (19)	C(5) - C(6) - C(7)	107.43 (15)
C(1) - C(2) - H(23)	110.90 (11)	C(8) - C(6) - C(9)	113.17 (13)
H(21) - C(2) - H(23)	111.30 (17)	C(5) - C(6) - C(9)	107.81 (13)
H(22) - C(2) - H(23)	102.90 (19)	C(7) - C(6) - C(9)	110.04 (14)
O(1) - C(3) - C(4)	108.42 (12)	C(6) - C(7) - H(71)	110.10 (17)
O(1) - C(3) - C(1)	112.57 (13)	C(6) - C(7) - H(72)	109.20 (15)
C(4) - C(3) - C(1)	113.99 (12)	H(71) - C(7) - H(72)	113.00 (2)
O(1) - C(3) - H(3)	103.80 (10)	C(6) - C(7) - H(73)	113.90 (16)
C(4) - C(3) - H(3)	108.30 (9)	H(71) - C(7) - H(73)	101.00 (2)
C(1) - C(3) - H(3)	109.20 (10)	H(72) - C(7) - H(73)	109.00 (2)
C(5) - C(4) - C(3)	113.21 (13)	O(3) - C(8) - O(2)	123.13 (17)
C(5) - C(4) - H(41)	109.30 (13)	O(3) - C(8) - C(6)	120.87 (16)
C(3) - C(4) - H(41)	106.90 (13)	O(2) - C(8) - O(6)	115.97 (15)
C(5) - C(4) - H(42)	110.60 (11)	C(10) - C(9) - C(6)	114.23 (13)
C(3) - C(4) - H(42)	109.90 (12)	C(10) - C(9) - C(1)	111.13 (13)
H(41) - C(4) - H(42)	106.70 (17)	C(6) - C(9) - C(1)	116.56 (12)

Table C3. Bond angles (deg.) for metabolite 1c. (continued)

Angles	(deg.)	Angles	(deg.)
C(10) - C(9) - H(9)	105.40 (12)	C(14) - C(13) - H(13)	107.30 (12)
C(6) - C(9) - H(9)	103.30 (11)	C(12) - C(13) - H(13)	103.00 (12)
C(1) - C(9) - H(9)	104.70 (11)	C(1) - C(13) - H(13)	104.10 (12)
C(11) - C(10) - C(9)	111.08 (13)	C(15) - C(14) - C(13)	116.40 (2)
C(11)-C(10)-H(101)	109.60 (14)	C(15) -C(14) - H(141)	108.40 (15)
C(9) - C(10) - H(101)	111.50 (13)	C(13) -C(14) - H(141)	105.60 (16)
C(11)-C(10)-H(102)	110.30 (12)	C(15) -C(14) - H(142)	104.70 (16)
C(9) - C(10) - H(102)	108.50 (13)	C(13) -C(14) - H(142)	114.10 (15)
H(101)-C(10)-H(102)	105.60 (17)	H(141)-C(10)-H(142)	107.00 (2)
O(4) - C(11) - C(10)	110.46 (14)	C(16) - C(15) - C(14)	112.00 (2)
O(4) - C(11) - C(12)	113.38 (14)	C(16) -C(15) - H(151)	111.00 (16)
C(10) - C(11) - C(12)	111.66 (14)	C(14) -C(15) - H(151)	109.10 (15)
O(4) - C(11) - H(11)	103.20 (13)	C(16) -C(15) - H(152)	110.10 (17)
C(10) - C(11) - H(11)	110.80 (12)	C(14) -C(15) - H(152)	104.20 (16)
C(12) - C(11) - H(11)	107.00 (12)	H(151)-C(15)- H(152)	110.00 (2)
C(11) - C(12) - C(17)	111.38 (16)	C(19) - C(16) - H(17)	101.30 (2)
C(11) - C(12) - C(18)	110.44 (15)	C(19) - C(16) - C(15)	110.00 (3)
C(17) - C(12) - C(18)	100.82 (18)	C(17) - C(16) - C(15)	108.00 (2)
C(11) - C(12) - C(13)	111.94 (13)	C(19) -C(16) - H(16)	111.60 (18)
C(17) - C(12) - C(13)	111.72 (15)	C(17) -C(16) - H(16)	115.70 (17)
C(18) - C(12) - C(13)	110.01 (16)	C(15) -C(16) - H(16)	109.90 (19)
C(14) - C(13) - C(12)	108.10 (14)	C(16) -C(17) - C(12)	102.40 (2)
C(14) - C(13) - C(1)	116.38 (13)	C(16) -C(17) - H(171)	110.10 (14)
C(12) - C(13) - C(1)	116.64 (13)	C(12) -C(17) - H(171)	113.90 (14)

Table C3. Bond angles (deg.) for metabolite 1c. (continued)

Angles	(deg.)	Angles	(deg.)
C(16)- C(17) -H(172)	109.40 (14)	C(20) - C(19) - C(16)	126.20 (3)
C(12)- C(17) -H(172)	108.40 (14)	C(20) - C(19) - C(18)	125.50 (3)
H(171)-C(17)-H(172)	112.00 (2)	C(16) - C(19) - C(18)	108.30 (2)
C(19) - C(18) - C(12)	104.80 (2)	C(19) -C(20)- H(20A)	120.00 (0)
C(19)-C(18)-H(181)	110.30 (16)	C(19) -C(20)- H(20B)	120.00 (0)
C(12)-C(18)-H(181)	111.60 (17)	H(20A)-C(20)-H(20B)	120.00 (0)
C(19)-C(18)-H(182)	107.90 (17)	C(3) -O(1) - H(1)	110.00 (2)
C(12)-C(18)-H(182)	110.70 (17)	C(8) -O(2) - H(2)	107.40 (18)
H(181)-C(18)-H(182)	111.00 (3)	C(11) -O(4) - H(4)	112.00 (18)

BIOGRAPHY

Miss Somjintana Taveepanich was born on March 2, 1976 in Bangkok Province, Thailand. She graduated with Bachelor Degree of Chemistry in 1997 from the Faculty of Science, Khon Khan University and Master Degree of Science in Organic Chemistry in 2000 from the Faculty of Science, Chulalongkorn University. Since 2001, she has studied for a Doctor of Philosophy Degree in Organic Chemistry at Department of Chemistry, Faculty of Science, Chulalongkorn University. She had received financial support from University Development Commission (UDC) scholarship and The Royal Golden Jubilee Ph.D. scholarship and the Graduate school, Faculty of Science, Chulalongkorn University.