CHEMISTRY
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Supporting Information

A Library of Chiral Imidazoline-Aminophenols: Discovering an Efficient Reaction Sphere

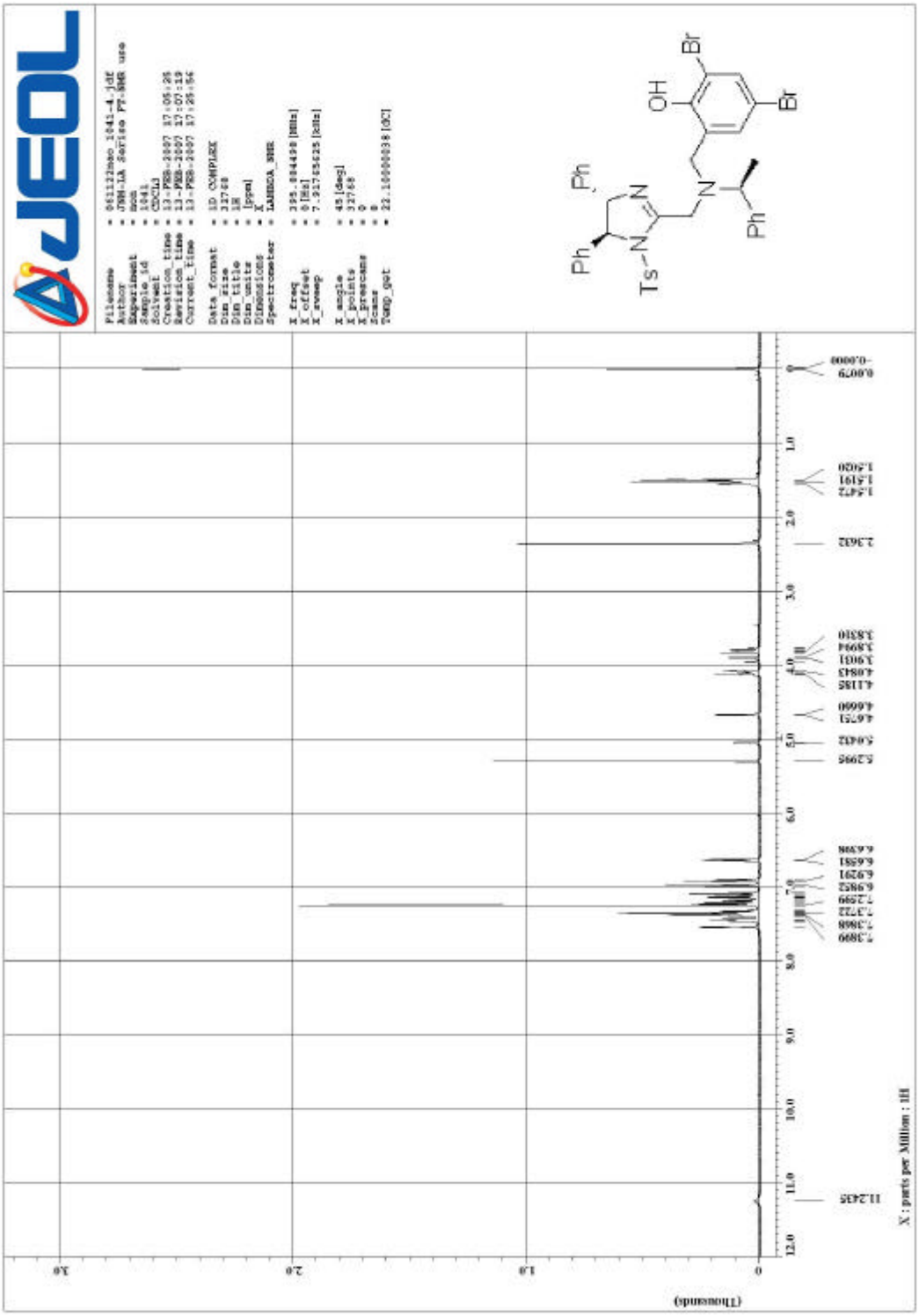
Takayoshi Arai,* Naota Yokoyama, Akira Yanagisawa

Experimental Procedure

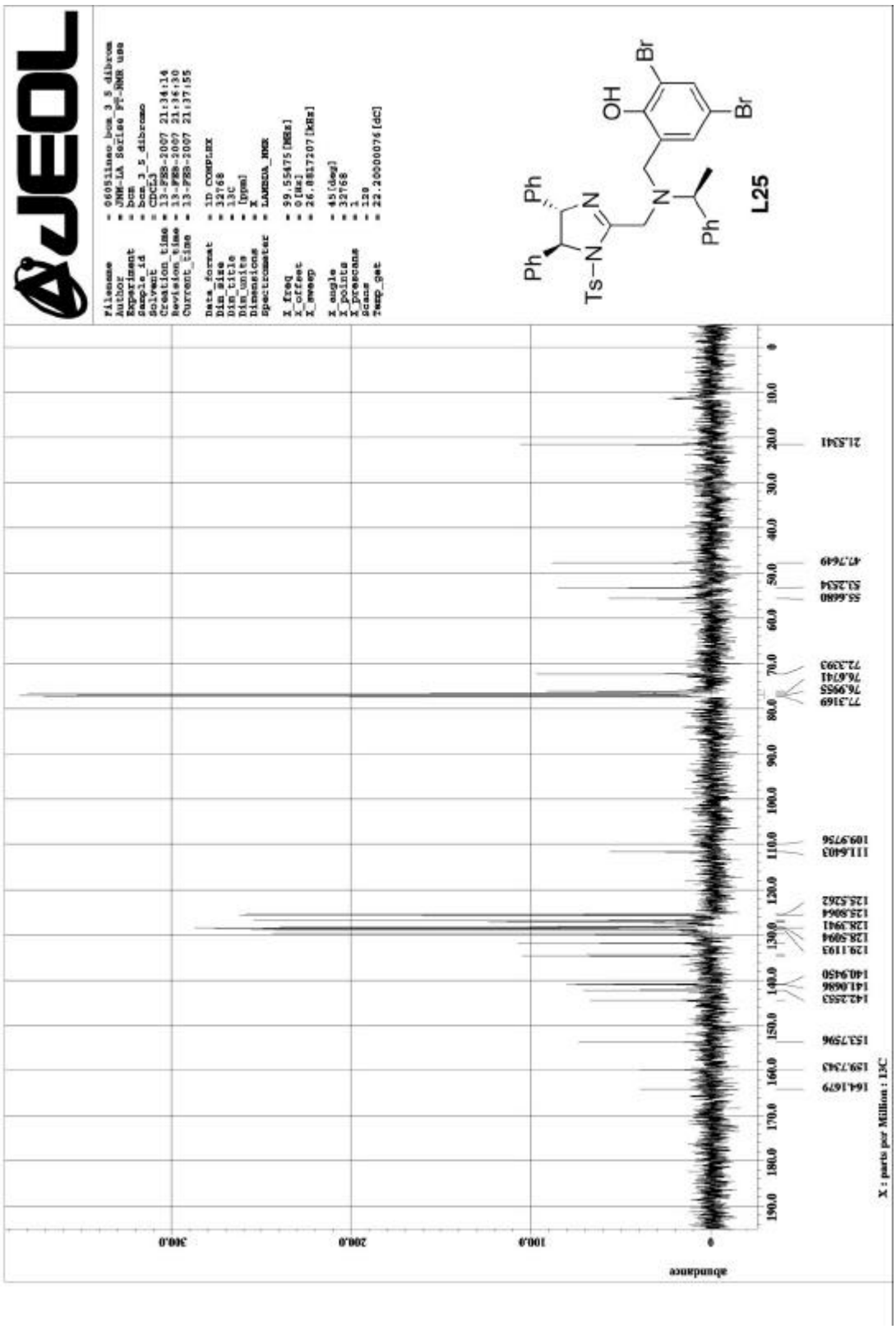
General.

Starting materials, reagents, and dry solvent were purchased from commercial suppliers and used without further purification. ^{1}H-NMR spectra were recorded on 400MHz spectrometers. Chemical shifts of ^{1}H NMR spectra were reported relative to tetramethyl silane (δ 0). Splitting patterns were reported as s, singlet; d, doublet; t, triplet; q, quartet; m, multiplet; br, broad.

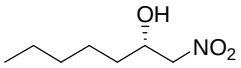
^{1}H-NMR of **L25**



^{13}C-NMR- of **L25**



(*S*)-1-nitroheptan-2-ol



The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=5:1) to give an colorless oil (78% yield). ^{1}H NMR (400MHz, $CDCl_3$) 4.28-4.46 (m, 3H, C**H**$_2$NO$_2$, C**H**OH), 1.48-1.60 (m, 2H), 1.48-1.60 (m, 2H), 1.25-1.34 (m, 6H), 0.88 (t, 3H, C**H**$_3$), ^{13}C NMR (100MHz, $CDCl_3$) . 13.7, 22.2, 24.6, 31.5, 33.6, 68.6, 80.8; Enantiomeric excess was determined by HPLC with a Chiralcel AD-H column (98:2 hexane:isopromanol, 0.8 mL/min, 220 nm); minor enantiomer t_r = 39.9 min, major enantiomer t_r = 52.8 min; 90% ee.

The other nitroaldols in Table 4 were identified as follows;

Entry 1: David A. Evans, Karl A. Scheidt, Keith R. Fandrick, Hon Wai Lam, Jimmy Wu, *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 2: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 3: Tommaso Marcelli, Richard N. S. van der Haas, Jan H. van Maarseveen, Henk Hiemstra *Synlett* **2005**, 2817-2819. (Absolute configuration was not reported.)

Entry 4: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 5: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 6: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 7: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 8: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 9: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

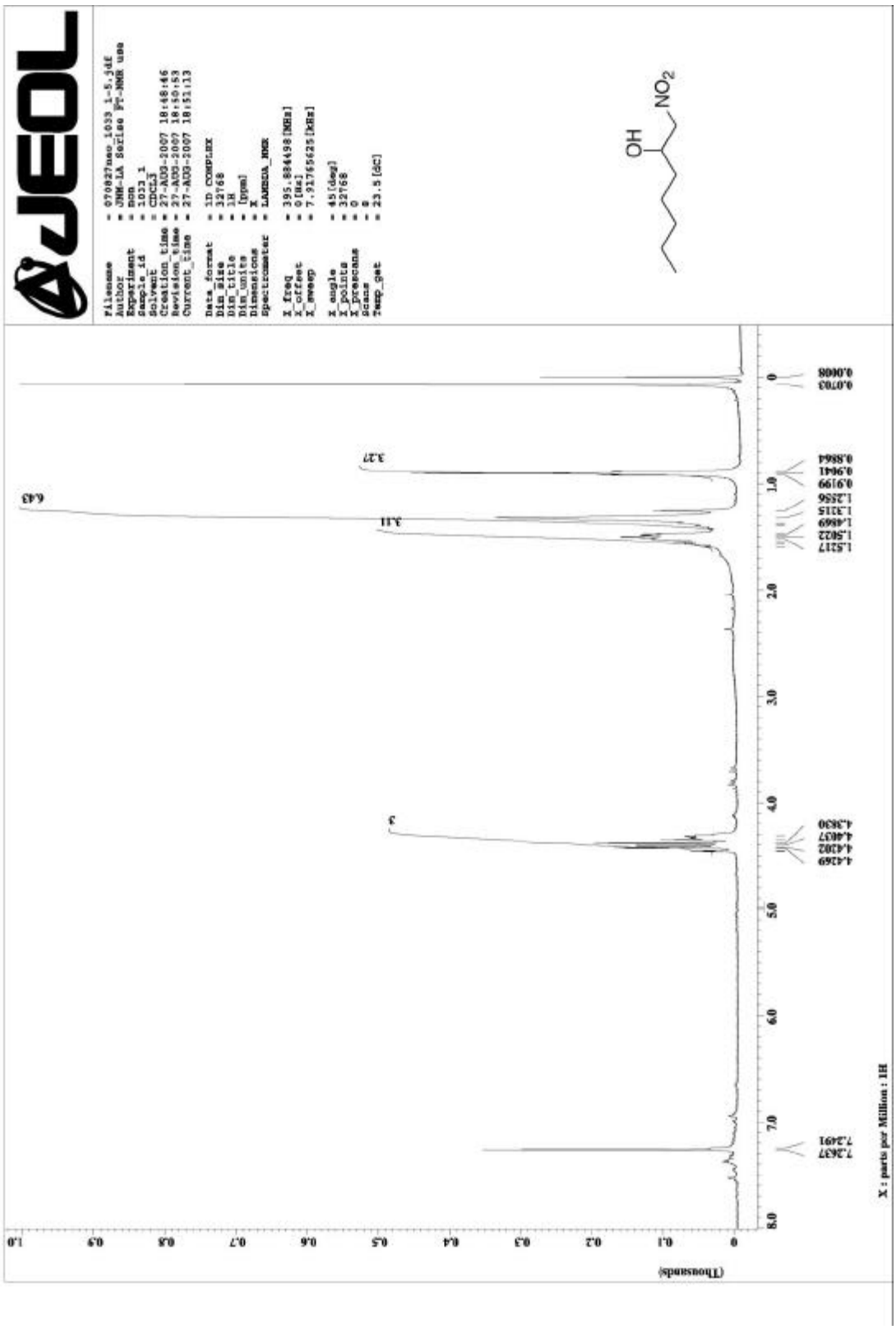
Entry 10: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 11: Hiroaki Sasai, Takeyuki Suzuki, Noriie Itoh, Masakatsu Shibasaki *Tetrahedron Letters*, **1993**, *34*, 851-854.

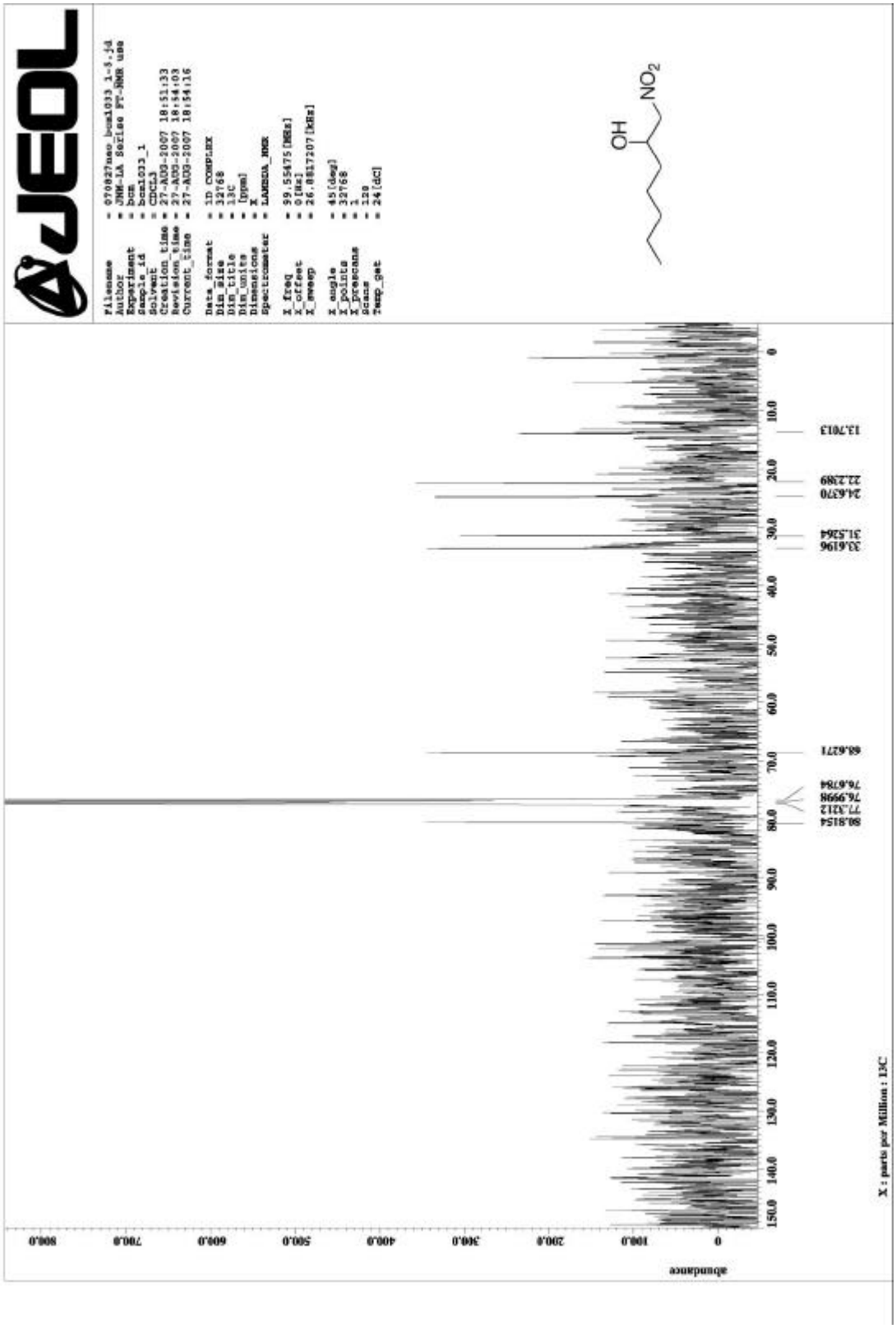
Entry 12: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

Entry 13: *J. Am. Chem. Soc.* **2003**, *125*, 12692-12693.

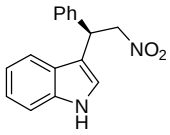
^{1}H-NMR of (*S*)-1-nitroheptan-2-ol



^{13}C-NMR of (*S*)-1-nitroheptan-2-ol

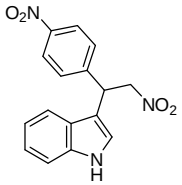


3-((*R*)-2-nitro-1-phenylethyl)-1*H*-indole



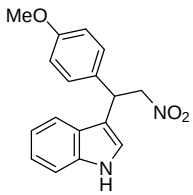
The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=3:1) to give an pale yellow solid (99% yield). ^{1}H NMR (400MHz, $CDCl_3$) 8.09 (br, 1H, N**H**), 7.02-7.46 (m, 10H, Ar**H**), 5.17-5.21 (m, 1H), 5.07 (dd, 1H, 12.4, 7.6 Hz), 4.94 (dd, 1H, 12.4, 8.3 Hz), ^{13}C NMR (100MHz, $CDCl_3$) δ 41.5, 79.5, 111.4, 114.3, 118.8, 119.9, 121.6, 122.6, 126.0, 127.5, 127.7, 128.9, 136.4, 139.1; Enantiomeric excess was determined by HPLC with a Chiralcel OD-H column (70:30 hexane:isopromanol, 0.7 mL/min, 254 nm); minor enantiomer t_r = 31.3 min, major enantiomer t_r = 36.4 min; 75% ee.

3-(2-nitro-1-(4-nitrophenyl)ethyl)-1*H*-indole



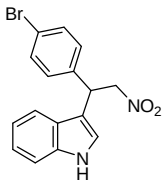
The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=3:1) to give an yellow solid (99% yield). ^{1}H NMR (400MHz, $CDCl_3$) 8.28 (br, 1H, N**H**), 8.14 (d, 1H, J=8.0 Hz, Ar**H**), 7.47-7.50 (m, 1H, Ar**H**), 7.33-7.38 (m, 2H, Ar**H**), 7.19-7.23 (m, 1H, Ar**H**), 7.06-7.10 (m, 1H, Ar**H**), 7.02-7.04 (m, 1H, Ar**H**), 5.26-5.29 (m, 1H), 5.08 (dd, 1H, J=12.8, 7.0), 4.97 (dd, 1H, J=12.8, 8.9); ^{13}C NMR (100MHz, $CDCl_3$) .41.2, 78.7, 111.6, 112.8, 118.4, 120.3, 121.6, 123.0, 124.1, 125.6, 128.7, 136.4, 146.7, 147.2 ; Enantiomeric excess was determined by HPLC with a Chiralcel OD-H column (70:30 hexane:isopromanol, 0.7 mL/min, 254 nm); minor enantiomer t_r = 55.9min, major enantiomer t_r = 66.9in; 80% ee.

3-(1-(4-methoxyphenyl)-2-nitroethyl)-1*H*-indole



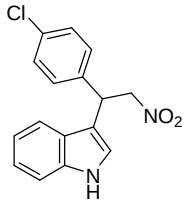
The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=3:1) to give an yellow solid (97% yield). ^{1}H NMR (400MHz, $CDCl_3$) 8.07 (br, 1H, N**H**), 8.14 (d, 1H, J=8.0Hz, Ar**H**), 7.42 (d, 1H, J=7.9Hz, Ar**H**), 7.34 (d, 1H, J=7.9Hz, Ar**H**), 7.22-7.25 (m, 1H, Ar**H**), 7.17-7.20 (m, 1H, Ar**H**), 7.05-7.08 (m, 1H, Ar**H**), 6.99-7.00 (m, 1H, Ar**H**), 6.82-6.85 (m, 2H, Ar**H**), 5.10-5.15 (m, 1H), 5.03 (dd, 1H, J=12.2, 7.7), 4.89 (dd, 1H, J=12.2, 7.5), 3.76 (s, 3H, O**Me**); ^{13}C NMR (100MHz, $CDCl_3$) . 40.8, 55.2, 76.7, 79.7, 111.3, 114.3, 114.7, 118.9, 119.9, 121.4, 122.6, 126.1, 128.8, 131.2, 136.5, 158.9; Enantiomeric excess was determined by HPLC with a Chiralcel OD-H column (70:30 hexane:isopromanol, 0.7 mL/min, 254 nm); minor enantiomer t_r = 23.8min, major enantiomer t_r = 26.9min; 55% ee.

3-(1-(4-bromophenyl)-2-nitroethyl)-1*H*-indole



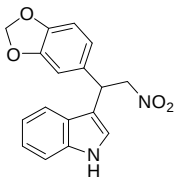
The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=3:1) to give an white solid (99% yield). ^{1}H NMR (400MHz, $CDCl_3$) 8.10 (br, 1H, N**H**), 7.32-7.44 (m, 4H, Ar**H**), 7.17-7.23 (m, 4H, Ar**H**), 7.07-7.09 (m, 1H, Ar**H**), 6.966-6.97 (m, 1H, Ar**H**), 5.11-5.15 (m, 1H), 5.01 (dd, 1H, J=12.5, 7.5), 4.88 (dd, 1H, J=12.5, 8.4); ^{13}C NMR (100MHz, $CDCl_3$) .41.0, 79.1, 111.4, 113.7, 118.7, 120.0, 121.5, 122.8, 125.8, 129.0, 129.4, 132.0, 136.4, 138.2; Enantiomeric excess was determined by HPLC with a Chiralcel OD-H column (70:30 hexane:isopromanol, 0.7 mL/min, 254 nm); minor enantiomer t_r = 26.8min, major enantiomer t_r = 33.4min; 75% ee.

3-(1-(4-chlorophenyl)-2-nitroethyl)-1*H*-indole



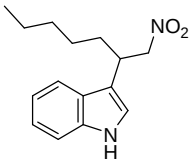
The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=3:1) to give an white solid (99% yield). ^{1}H NMR (400MHz, $CDCl_3$) 8.10 (br, 1H, N**H**), 7.32-7.39 (m, 4H, Ar**H**), 7.13-7.28 (m, 6H, Ar**H**), 7.05-7.09 (m, 1H, Ar**H**), 6.96-6.97 (m, 1H, Ar**H**), 5.12-5.16 (m, 1H), 5.02 (dd, 1H, J=12.4, 7.3), 4.88 (dd, 1H, J=12.4, 8.7); ^{13}C NMR (100MHz, $CDCl_3$) .40.9, 79.2, 111.4, 113.8, 118.7, 120.0, 121.5, 122.7, 128.2, 129.05, 129.1, 133.4, 136.4, 137.7; Enantiomeric excess was determined by HPLC with a Chiralcel OD-H column (70:30 hexane:isopromanol, 0.7 mL/min, 254 nm); minor enantiomer t_r = 24.9min, major enantiomer t_r = 27.1min; 74% ee.

3-(1-benzo[d][1,3]dioxol-5-yl)-2-nitroethyl)-1*H*-indole



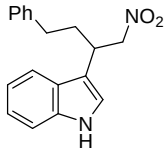
The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=3:1) to give an white solid (86% yield). ^{1}H NMR (400MHz, $CDCl_3$) 8.09 (br, 1H, N**H**), 6.73-7.44 (m, 9H, Ar**H**), 5.89-5.91 (m, 2H), 5.07-5.11 (m, 1H), 5.01 (dd, 1H, J=12.3, 7.5), 4.88 (dd, 1H, J=12.3, 8.2); ^{13}C NMR (100MHz, $CDCl_3$) .40.9, 79.2, 111.4, 113.8, 118.7, 120.0, 121.5, 122.7, 128.2, 129.05, 129.1, 133.4, 136.4, 137.7; Enantiomeric excess was determined by HPLC with a Chiralcel OD-H column (70:30 hexane:isopromanol, 0.7 mL/min, 254 nm); minor enantiomer t_r =29.3min, major enantiomer t_r = 36.3min; 67% ee.

3-(1-nitroheptan-2-yl)-1*H*-indole



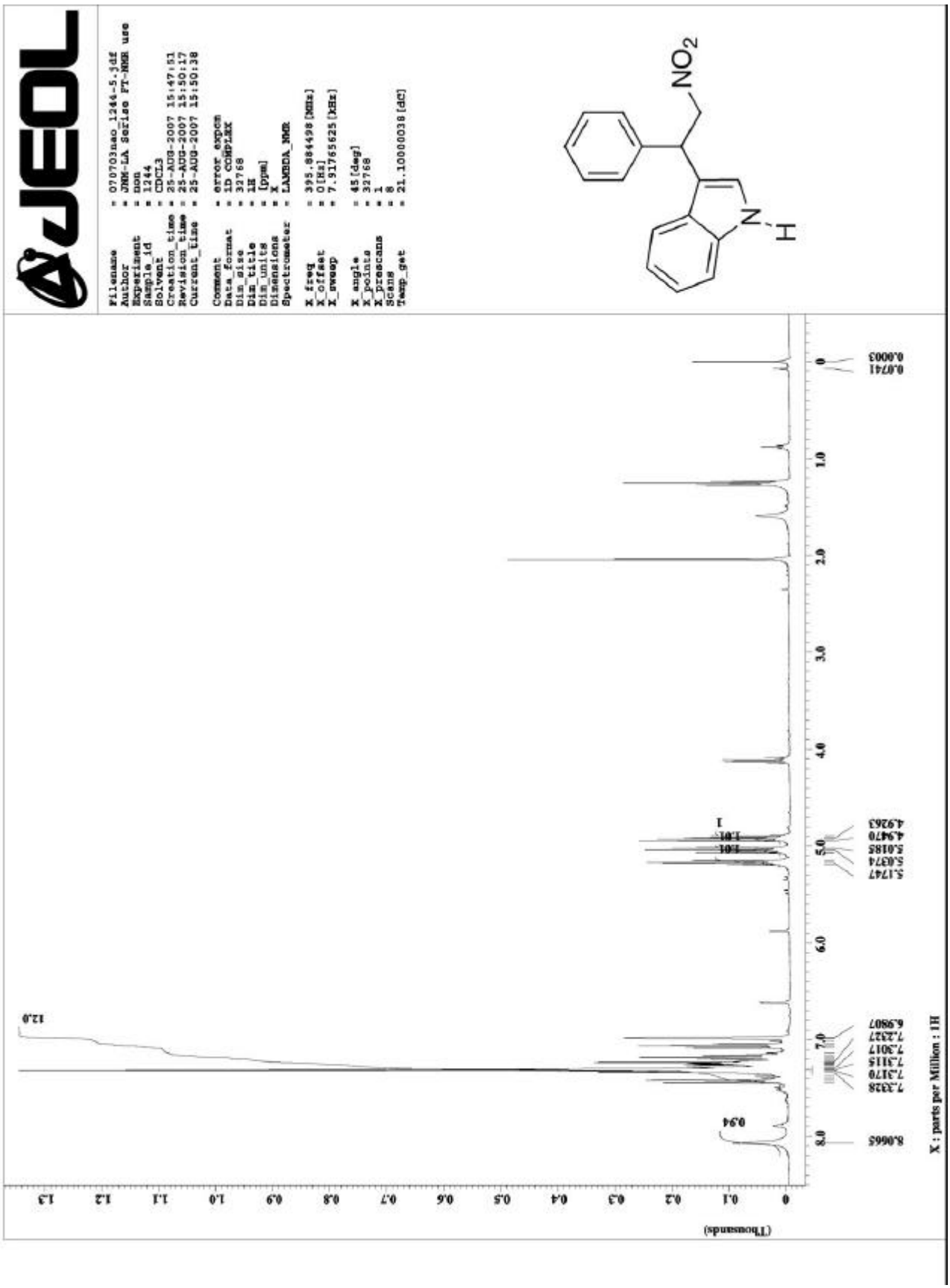
The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=4:1) to give an yellow oil (97% yield). ^{1}H NMR (400MHz, $CDCl_3$) 8.03 (br, 1H, N**H**), 7.54 (d, 1H, J=8.0 Hz, Ar**H**), 7.27 (m, 1H, Ar**H**), 7.03-7.15 (m, 2H, Ar**H**), 6.91 (m, 1H, Ar**H**), 4.56 (m, 1H), 3.70 (m, 1H), 1.64-1.83 (m, 2H), 1.09-1.28 (m, 6H) 0.74 (t, 3H, J=7.0Hz); ^{13}C NMR (100MHz, $CDCl_3$) .13.9, 22.4, 26.8, 31.5, 32.3, 36.3, 80.6, 111.5, 114.0, 118.7, 119.7, 121.9, 122.3, 126.1, 136.4 ; Enantiomeric excess was determined by HPLC with a Chiralcel OD-H column (70:30 hexane:isopromanol, 0.7 mL/min, 254 nm); minor enantiomer t_r = 41.4min, major enantiomer t_r = 35.5min; 79% ee.

3-(1-nitro-4-phenylbutan-2-yl)-1*H*-indole

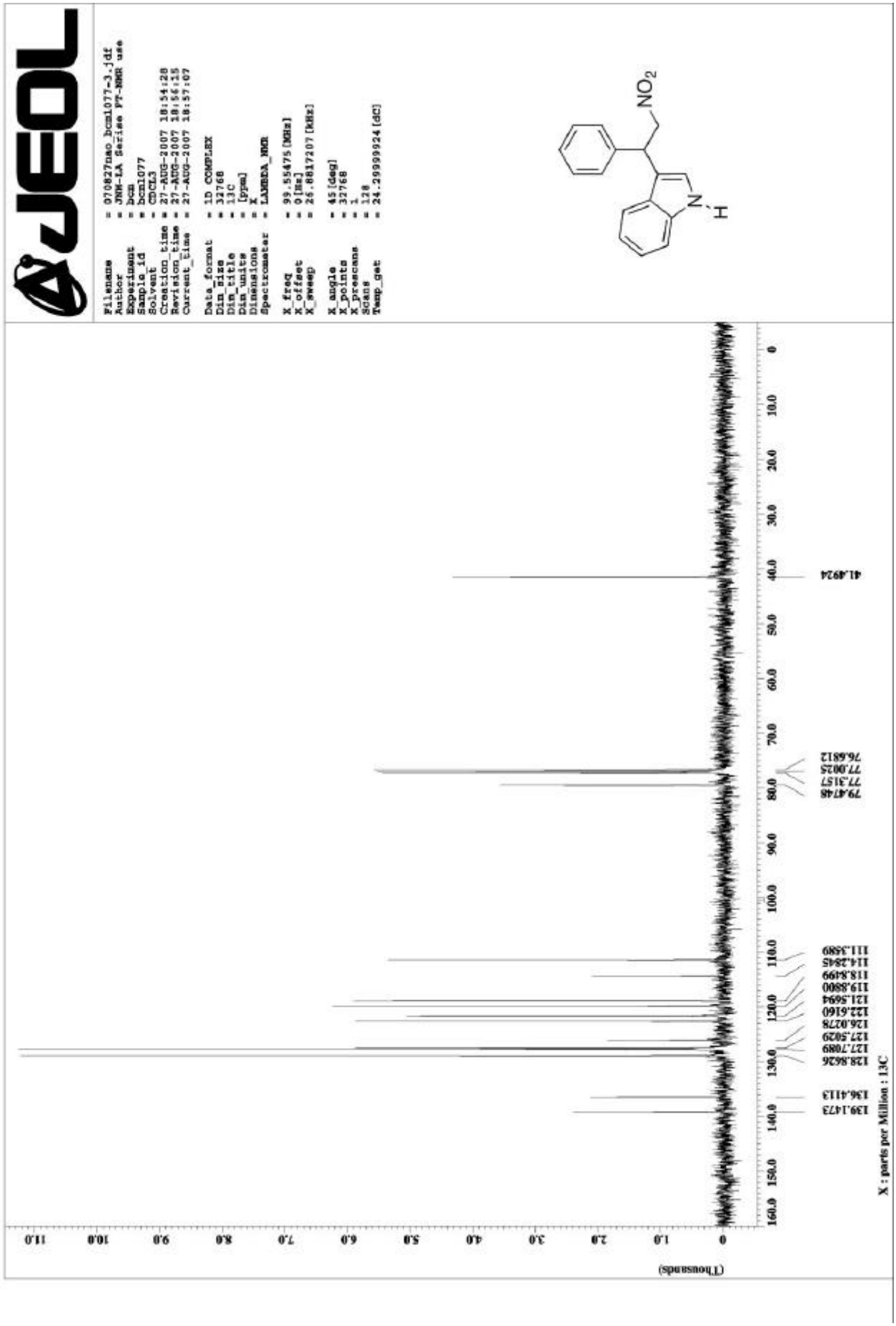


The title compound was prepared according to the General Procedure and purified by column chromatography (Hexane:AcOEt=4:1) to give an yellow oil (97% yield). ^{1}H NMR (400MHz, $CDCl_3$) 8.07 (br, 1H, N**H**), 7.60 (d, 1H, J=7,9 Hz, Ar**H**), 7.36 (d, 1H, J=8.2 Hz, Ar**H**), 7.01-7.27 (m, 8H, Ar**H**), 4.59-4.69 (m, 1H), 3.70 (m, 1H), 3.76-3.84 (m, 1H), 2.50-2.67 (m, 2H), 2.05-2.25 (m, 2H; ^{13}C NMR (100MHz, $CDCl_3$) .33.2, 33.9, 35.9, 80.4, 111.6, 113.4, 118.7, 119.8, 122.2, 125.98, 126.0, 128.3, 136.5, 141.2; Enantiomeric excess was determined by HPLC with a Chiralcel OD-H column (70:30 hexane:isopromanol, 0.7 mL/min, 254 nm); minor enantiomer t_r = 27.8min, major enantiomer t_r = 26.4min; 83% ee.

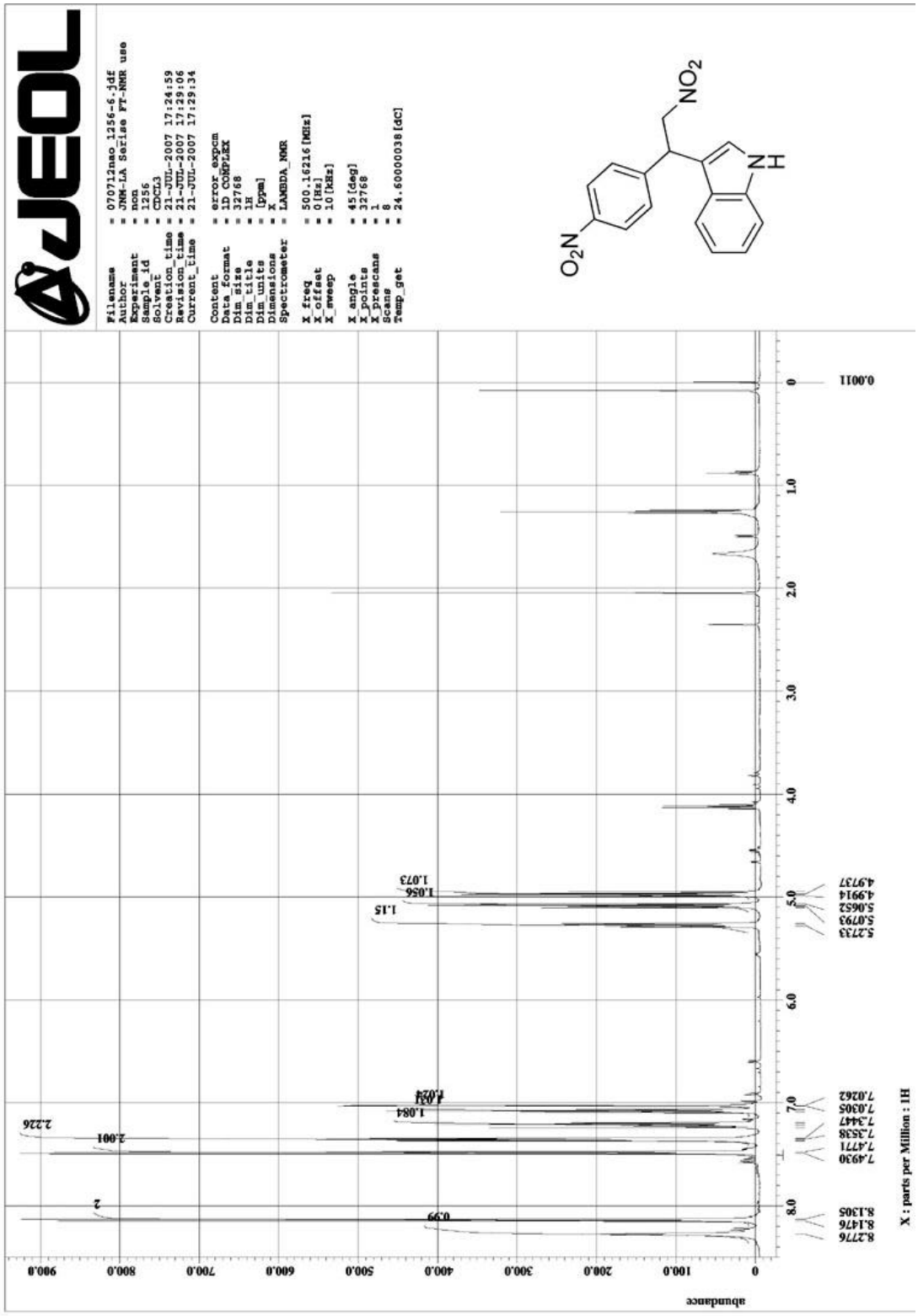
[1]H-NMR of the product obtained in entry 1, Table 5



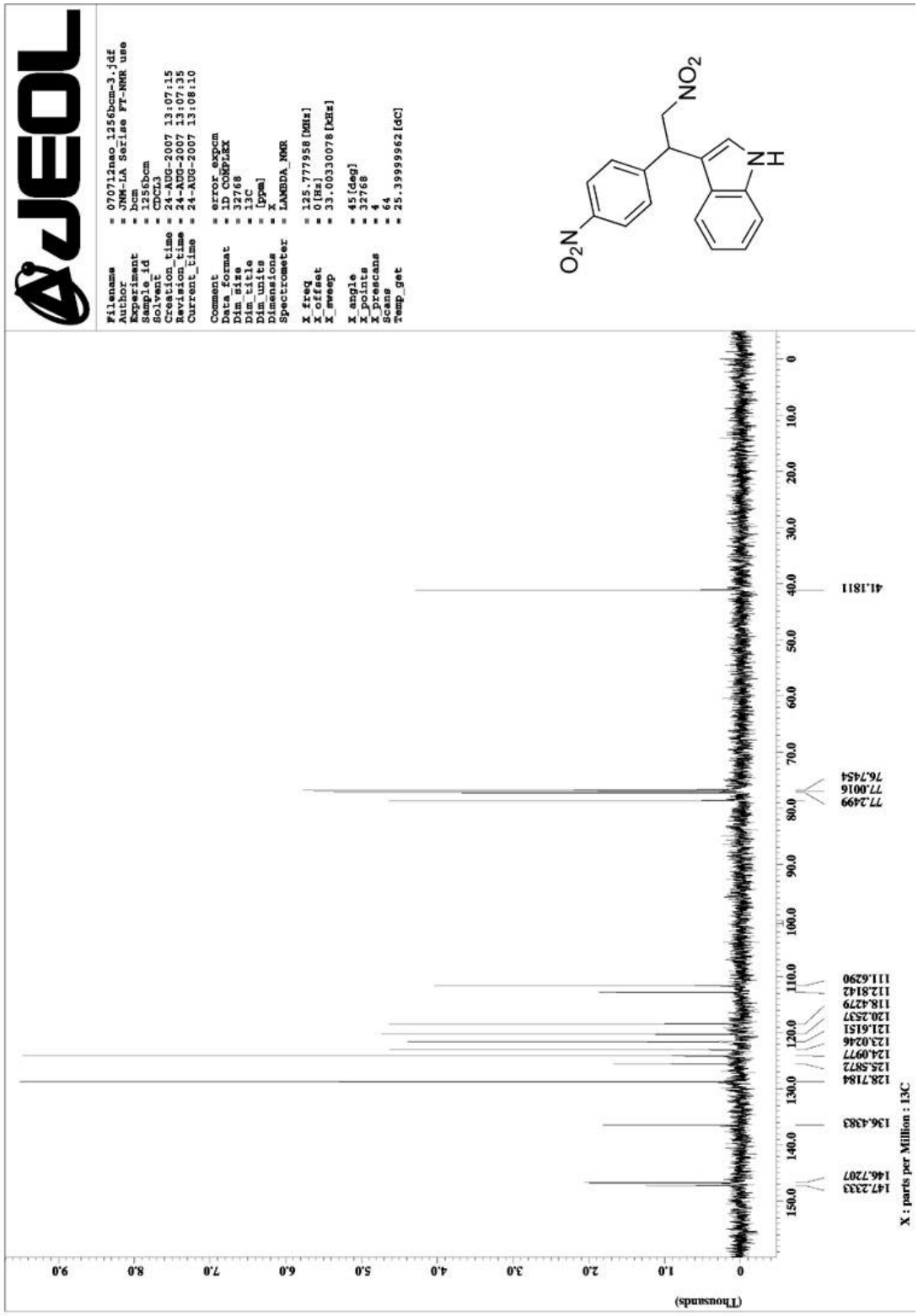
^{13}C-NMR of the product obtained in entry 1, Table 5



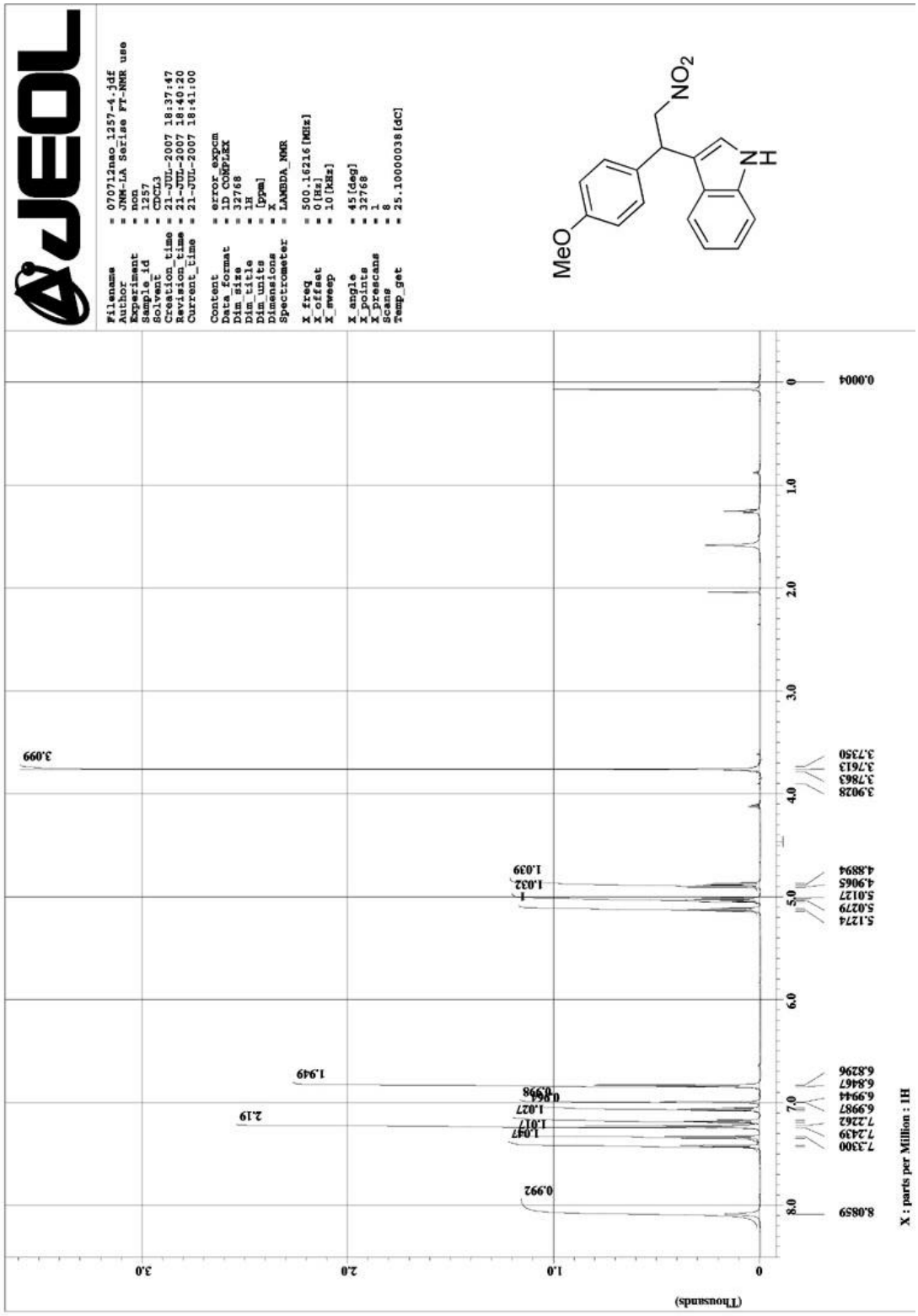
[1]H-NMR of the product obtained in entry 2, Table 5



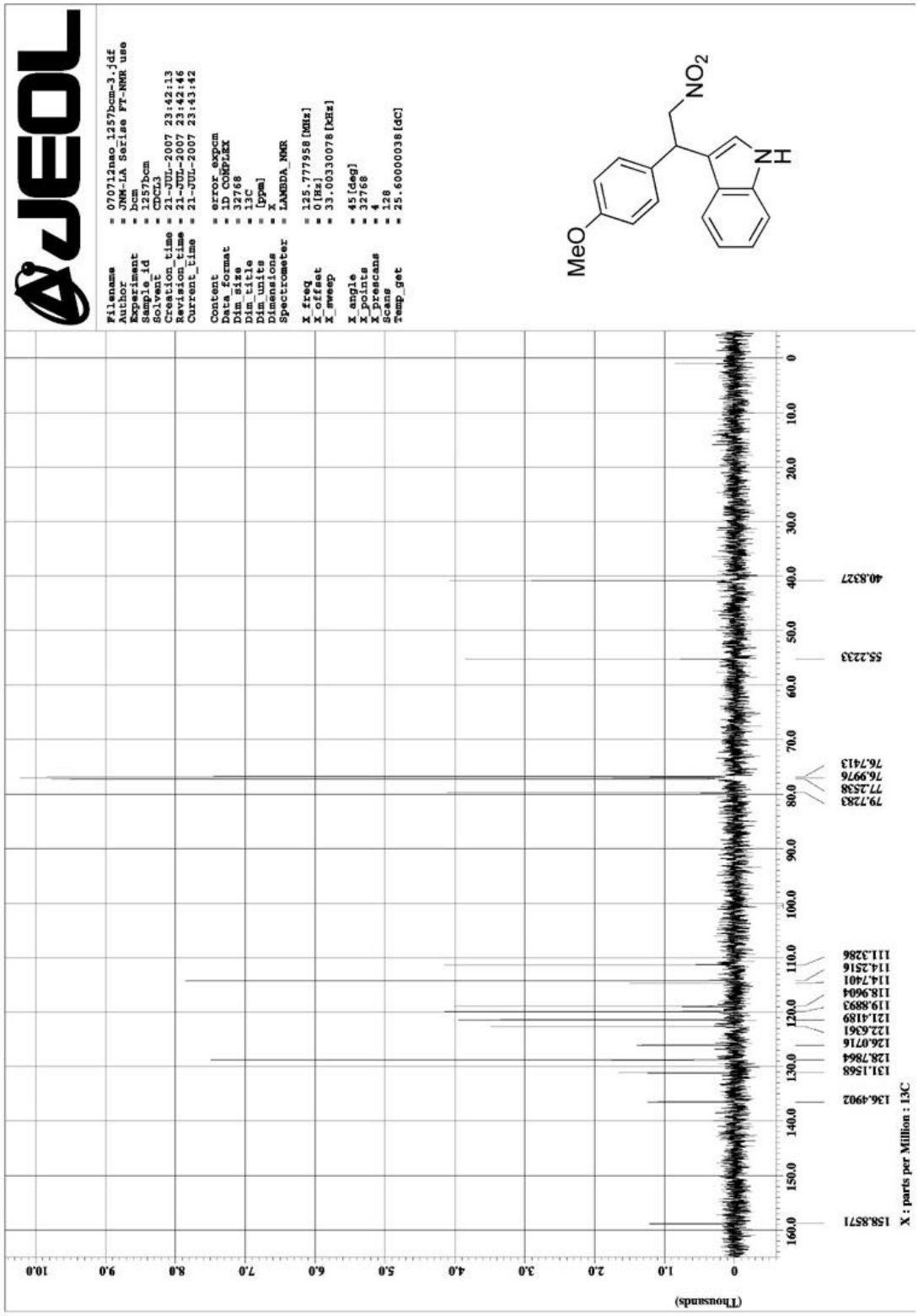
^{13}C-NMR of the product obtained in entry 2, Table 5



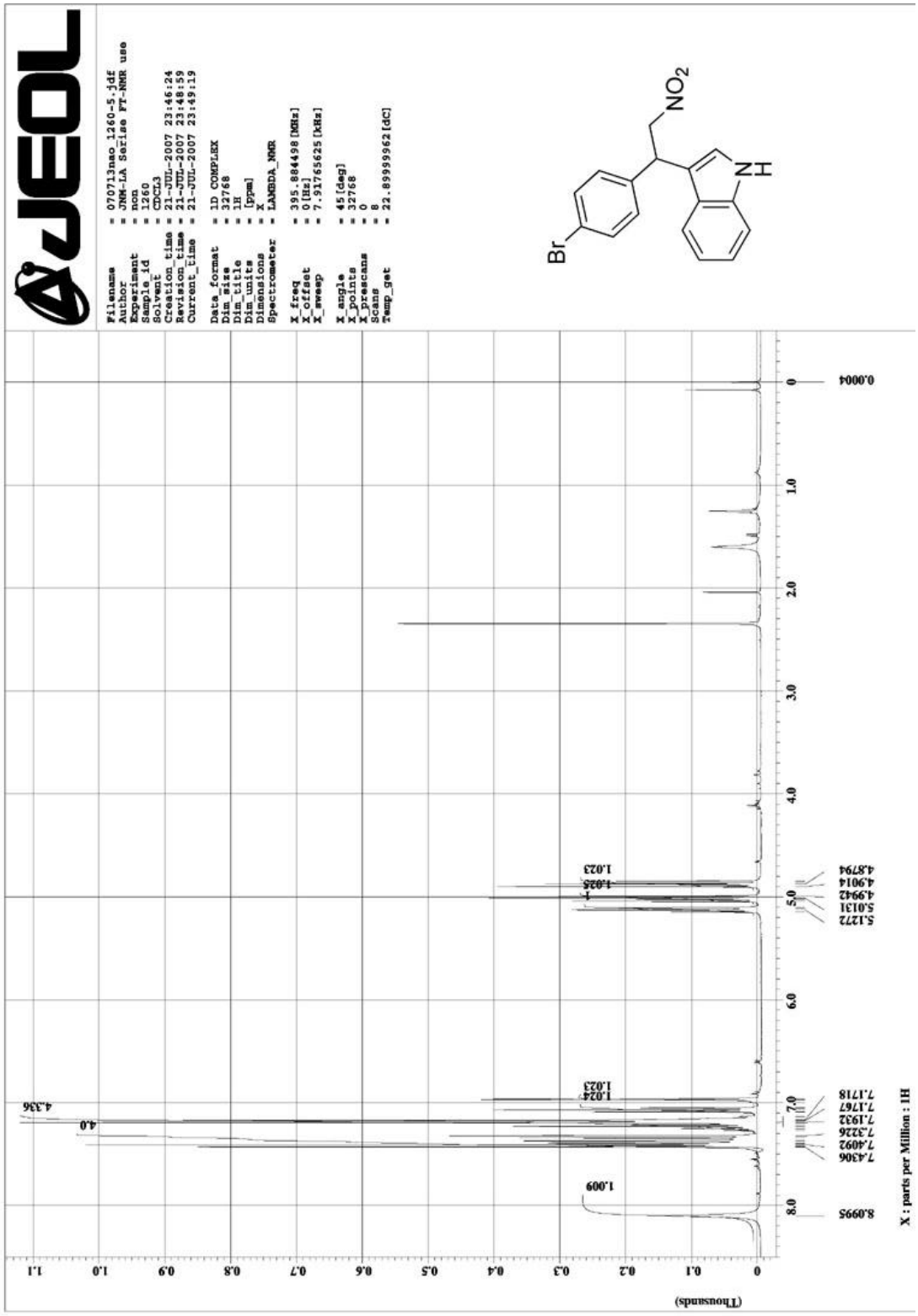
[1]H-NMR of the product obtained in entry 3, Table 5



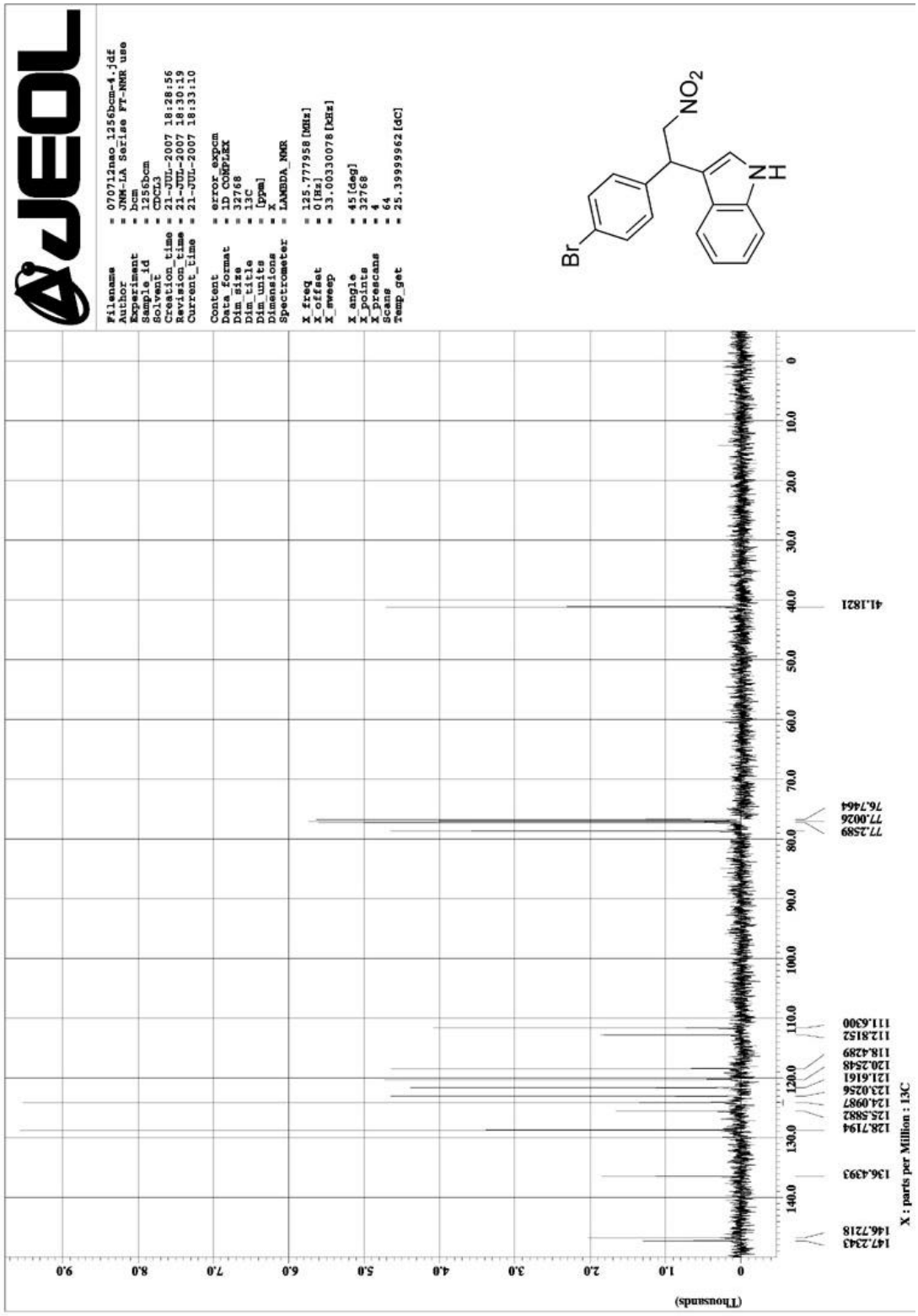
^{13}C-NMR of the product obtained in entry 3, Table 5



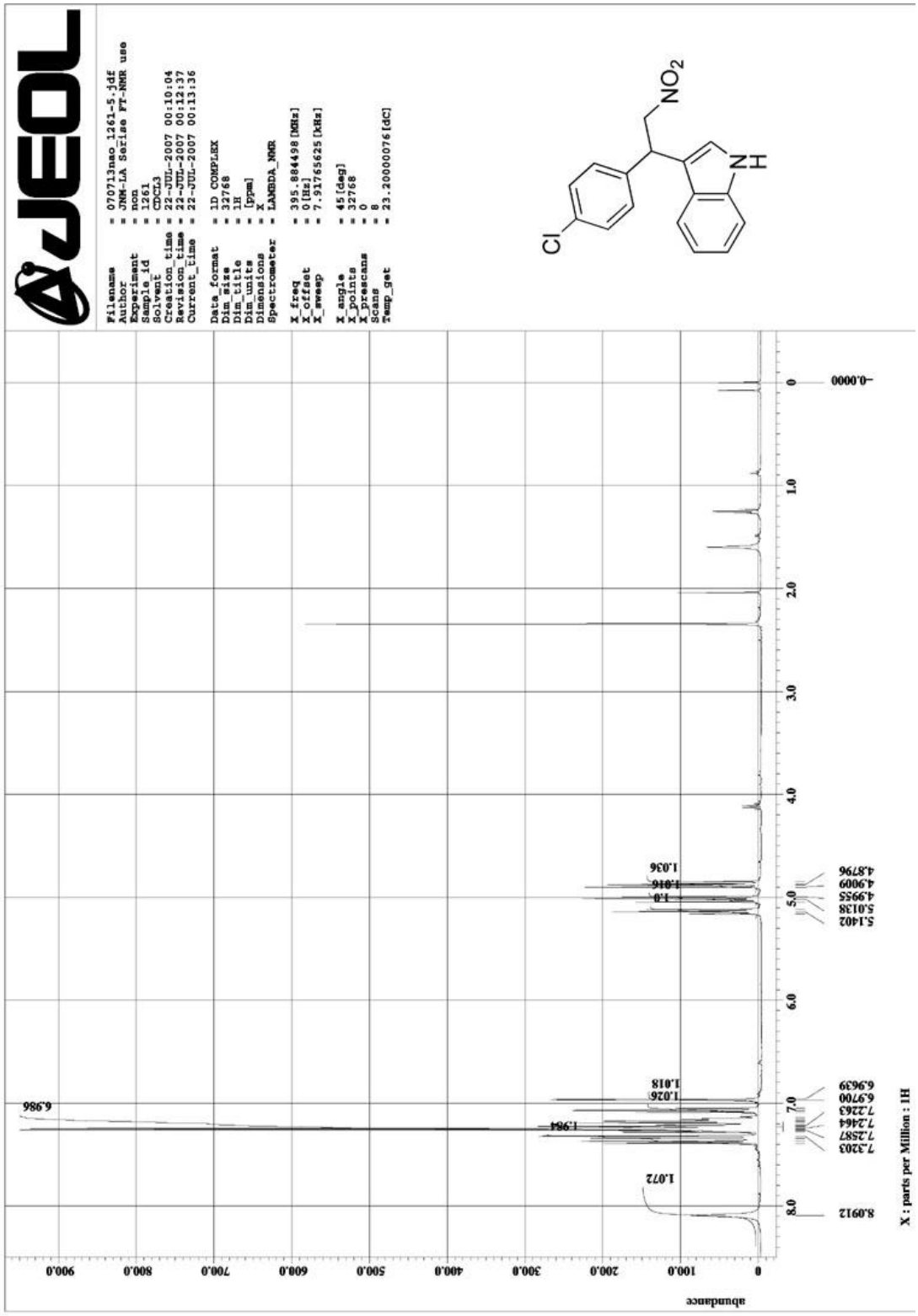
[1]H-NMR of the product obtained in entry 4, Table 5



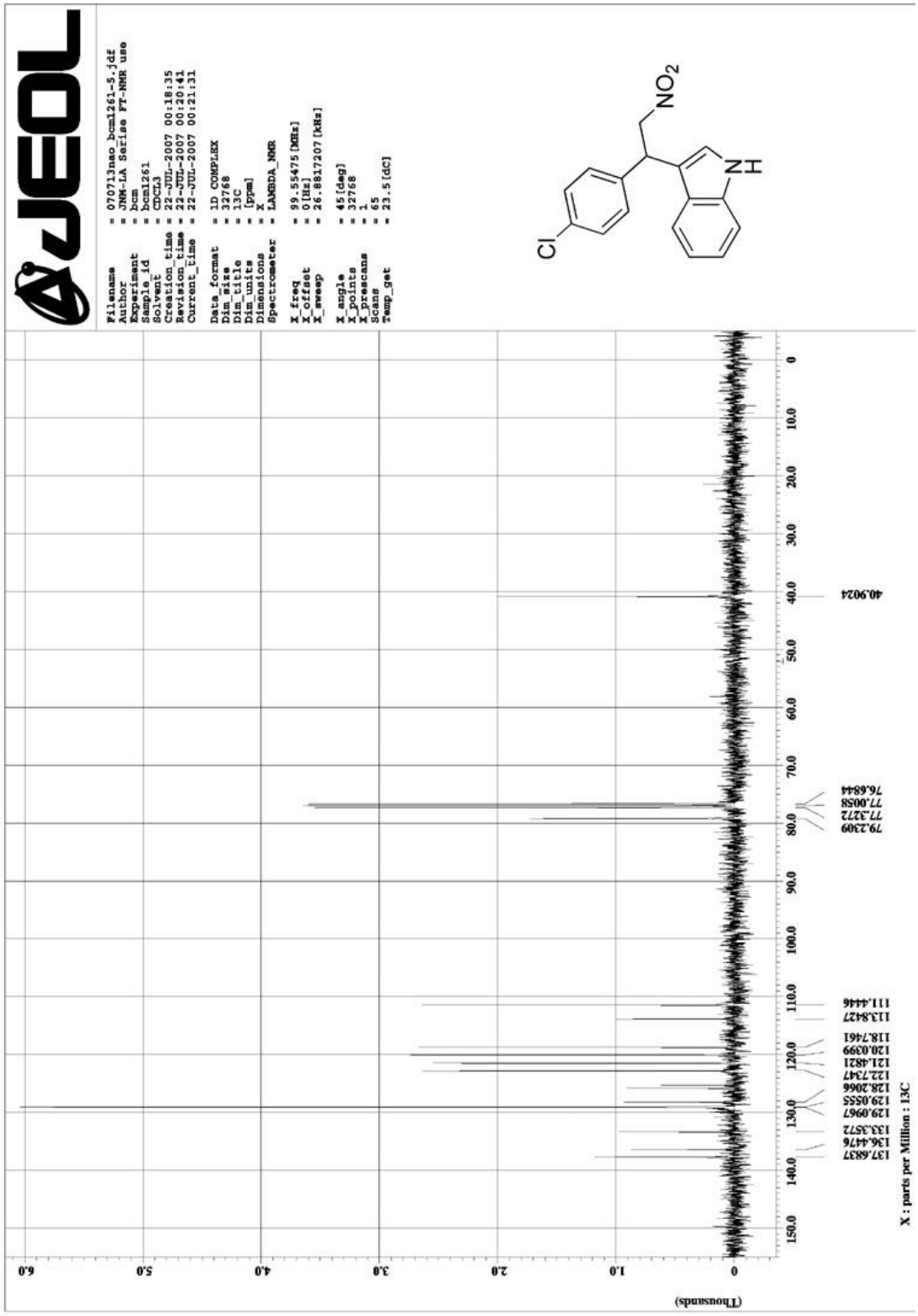
^{13}C-NMR of the product obtained in entry 4, Table 5



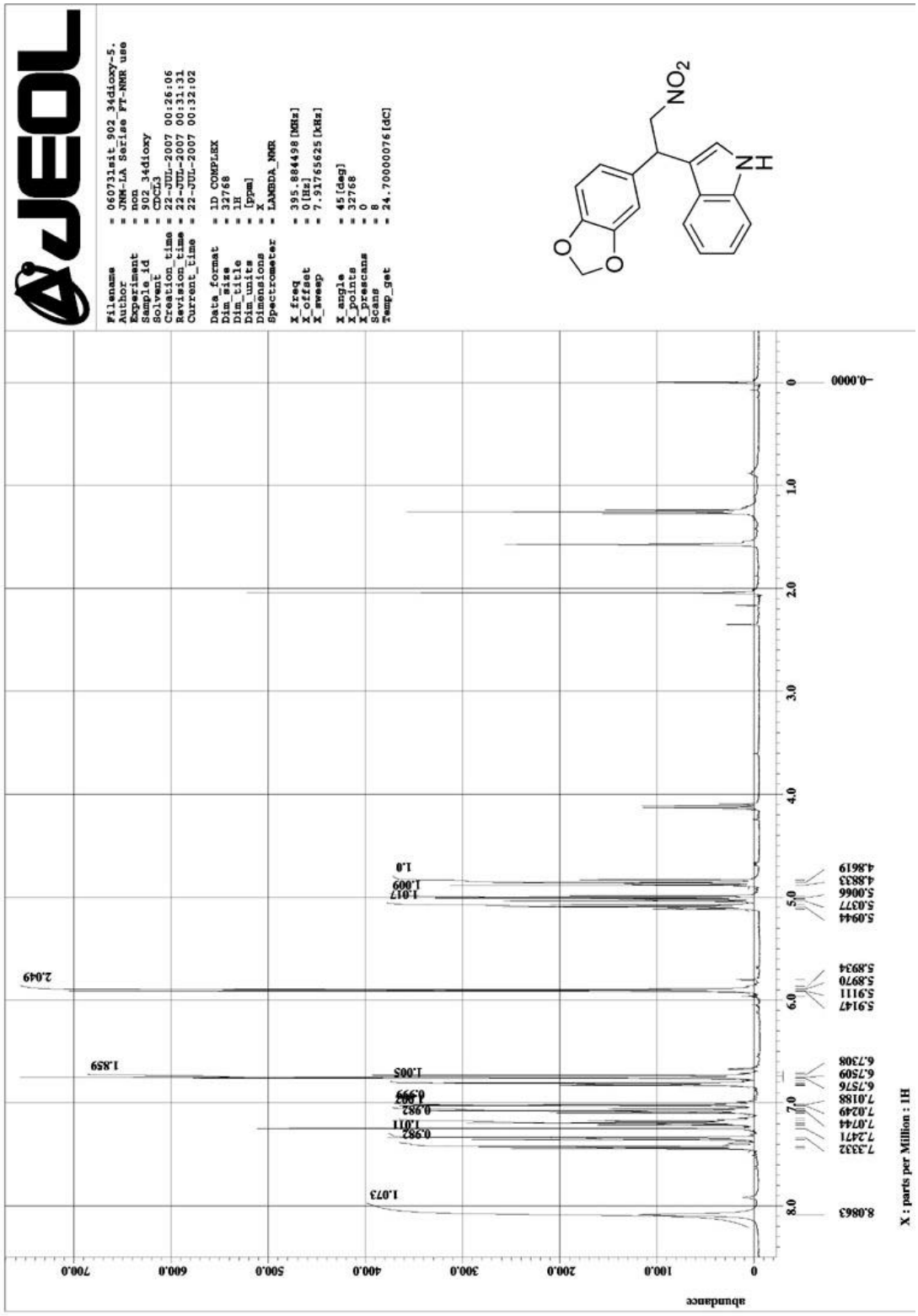
[1]H-NMR of the product obtained in entry 5, Table 5



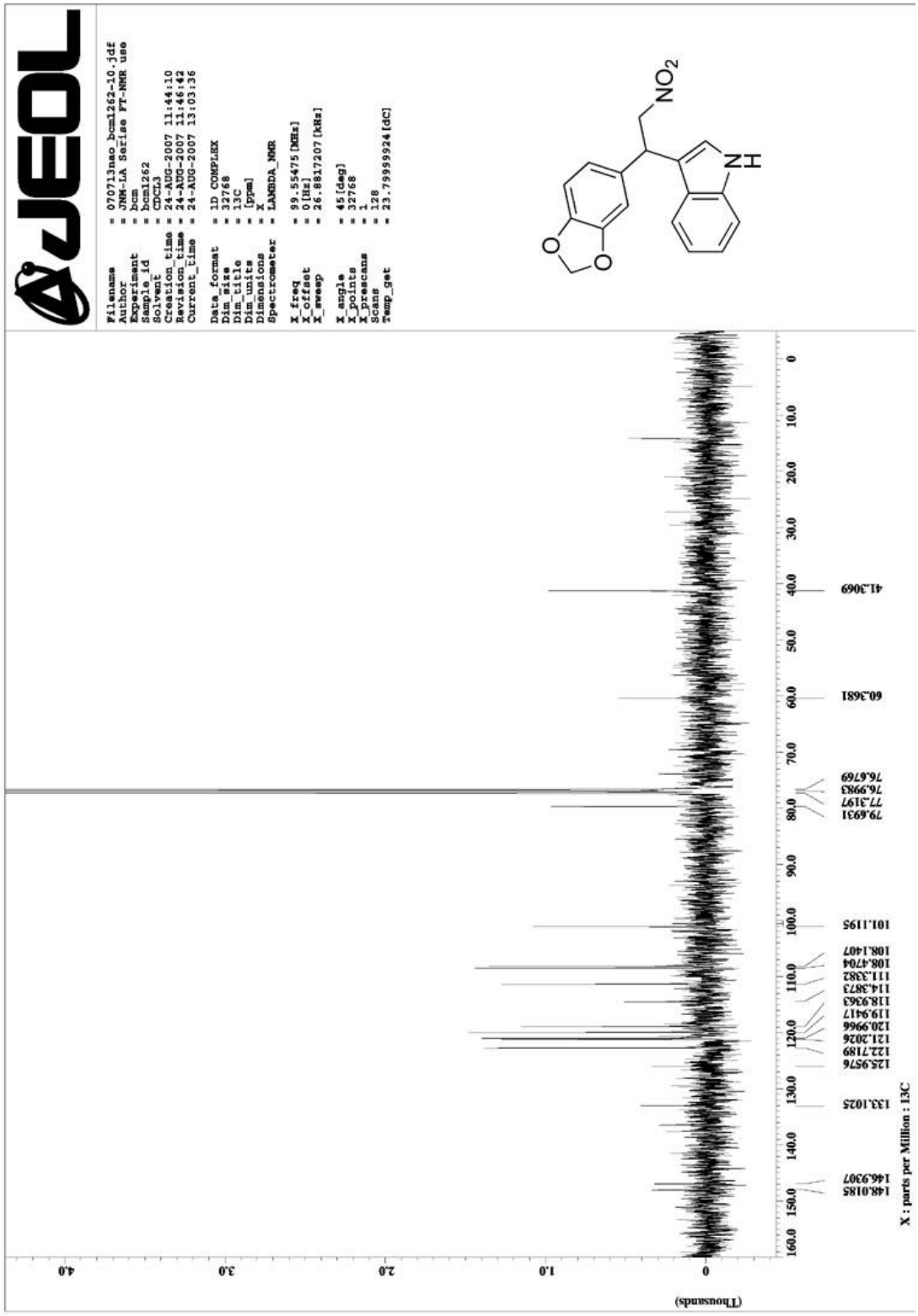
^{13}C-NMR of the product obtained in entry 5, Table 5



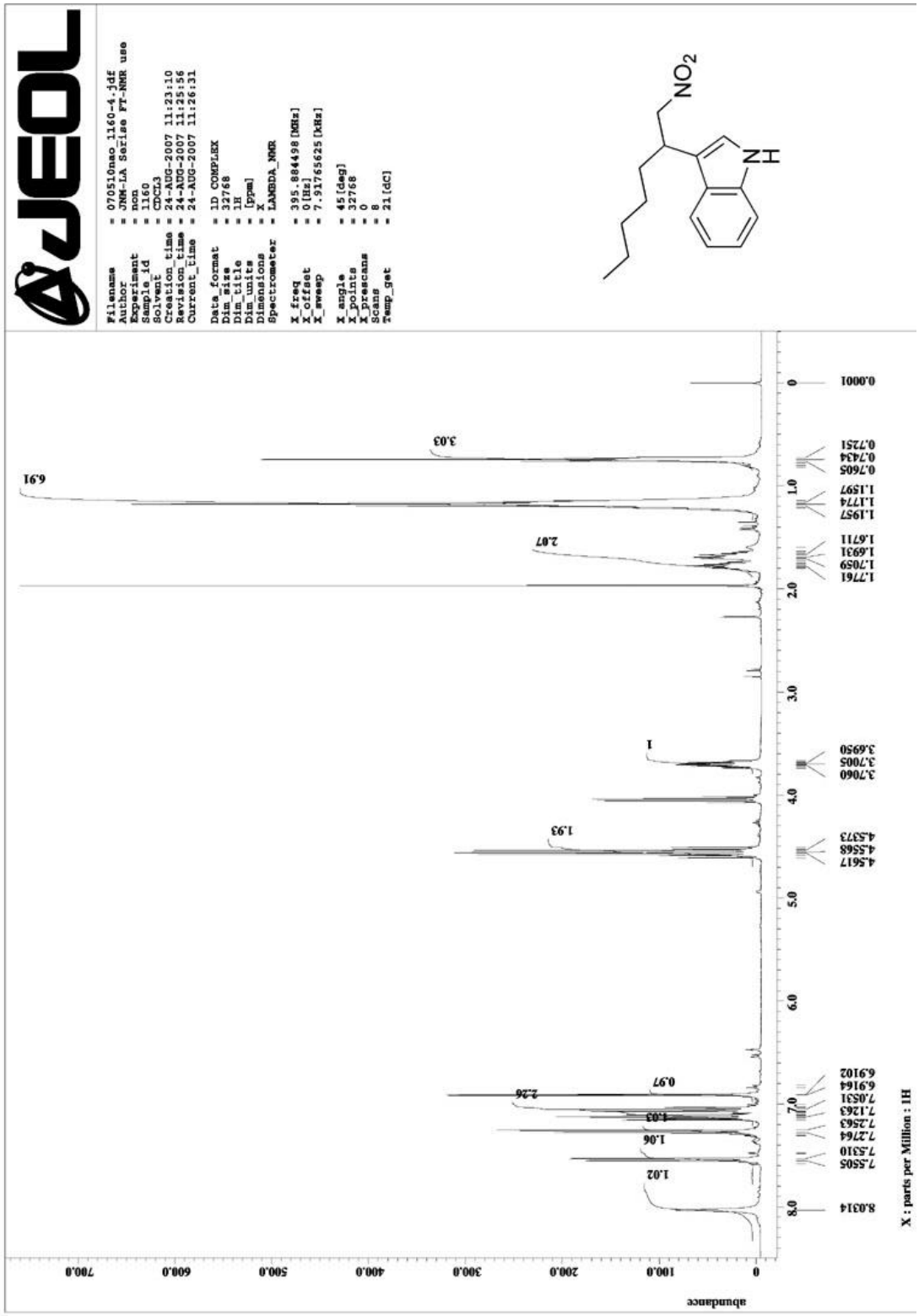
[1]H-NMR of the product obtained in entry 6, Table 5



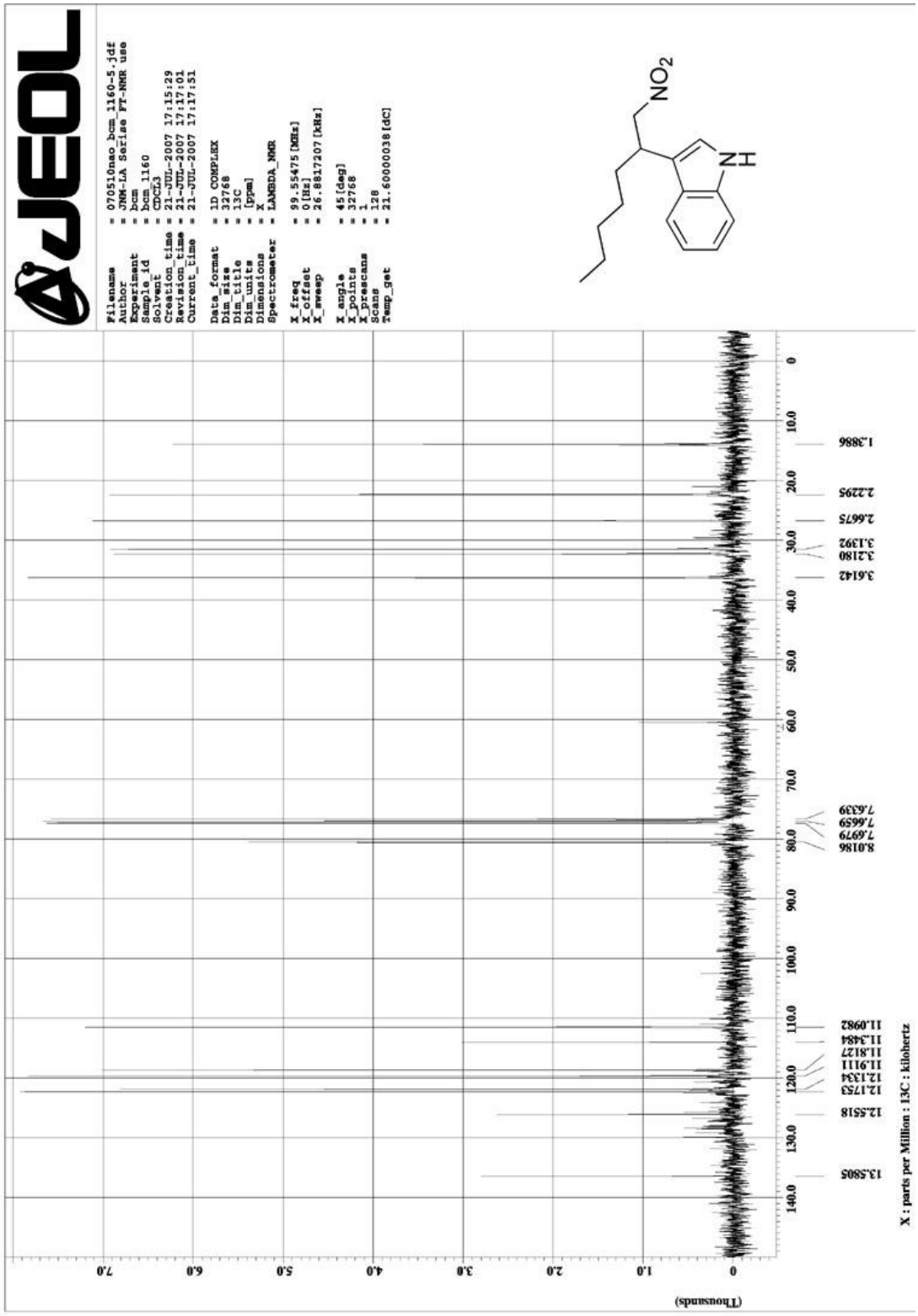
^{13}C-NMR of the product obtained in entry 6, Table 5



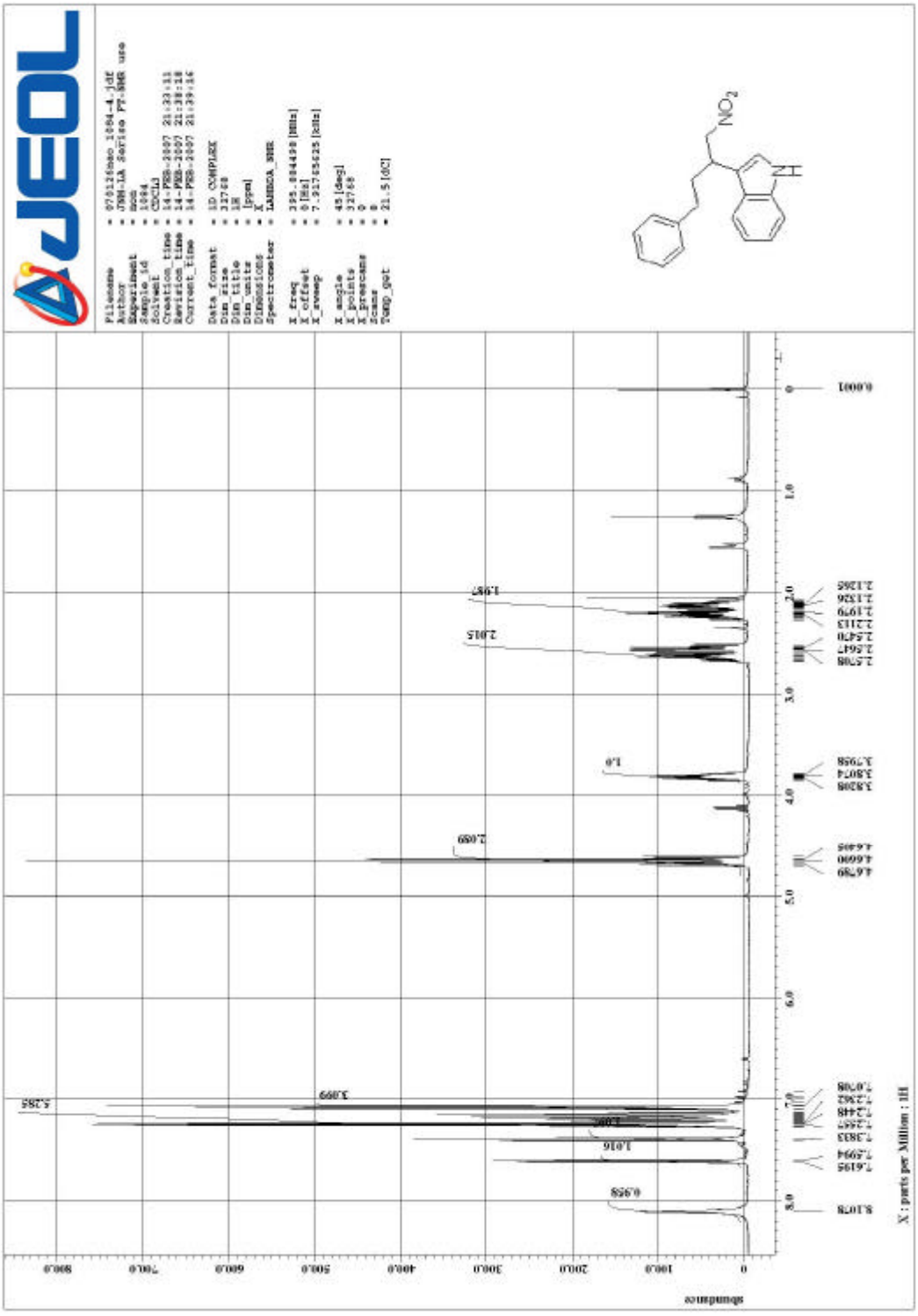
[1]H-NMR of the product obtained in entry 7, Table 5



^{13}C-NMR of the product obtained in entry 7, Table 5



[1]H-NMR of the product obtained in entry 8, Table 5



^{13}C-NMR of the product obtained in entry 8, Table 5