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APPENDICES

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APPENDIX A

SPECTRA OF SYNTHESIZED COMPOUNDS

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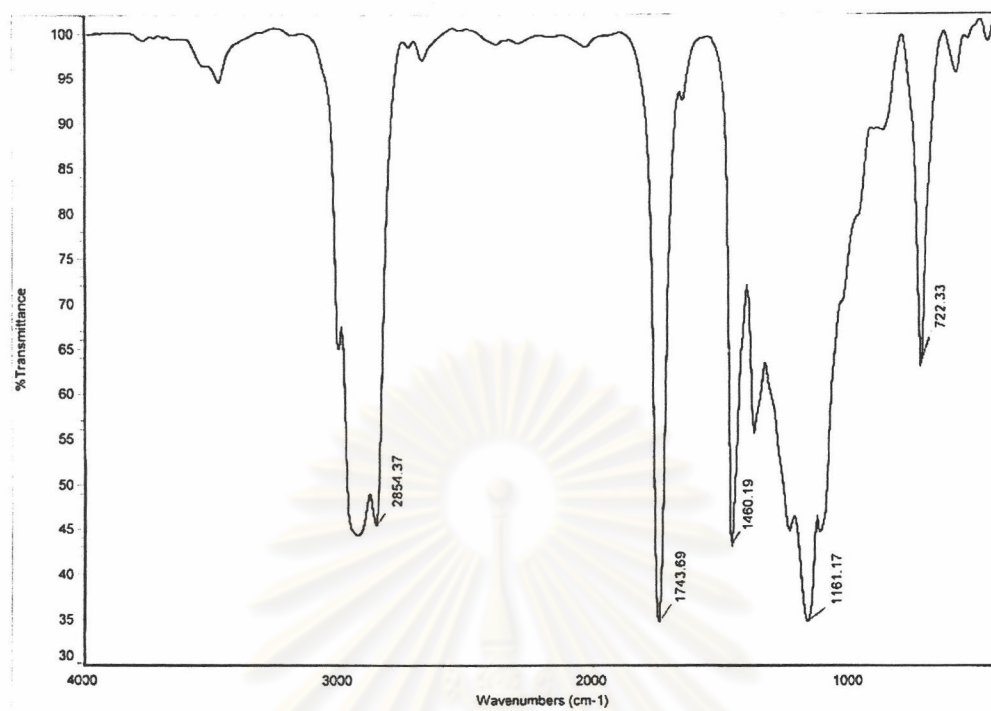


Figure A1 FTIR Spectrum of Palm Oil (NaCl)

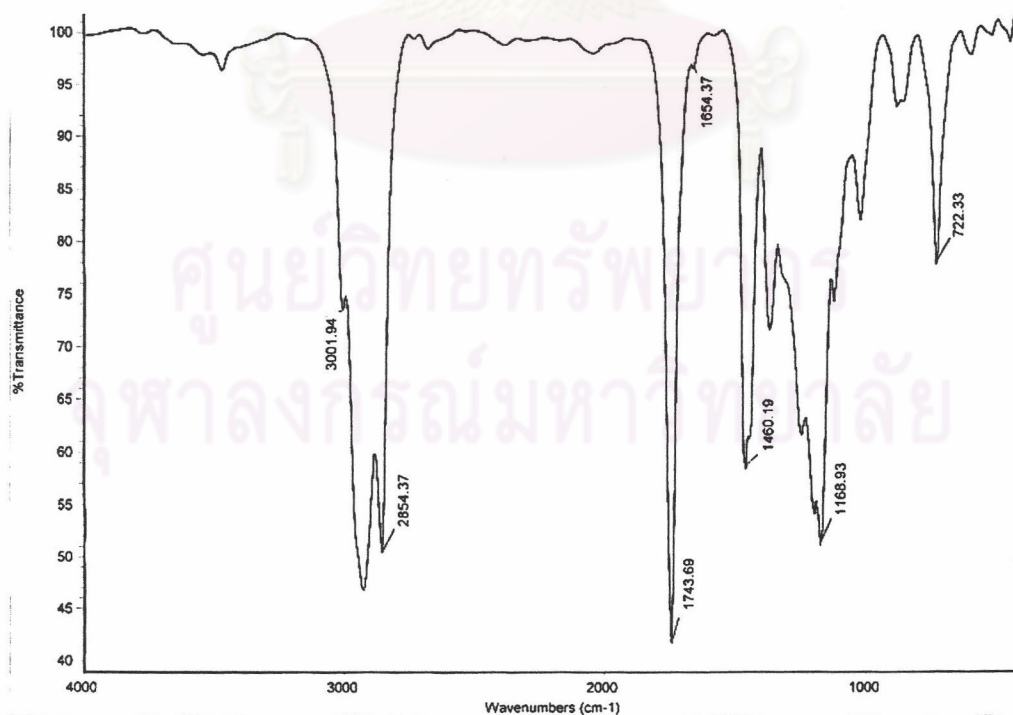


Figure A2 FTIR Spectrum of Palm Oil Methyl Ester (NaCl)

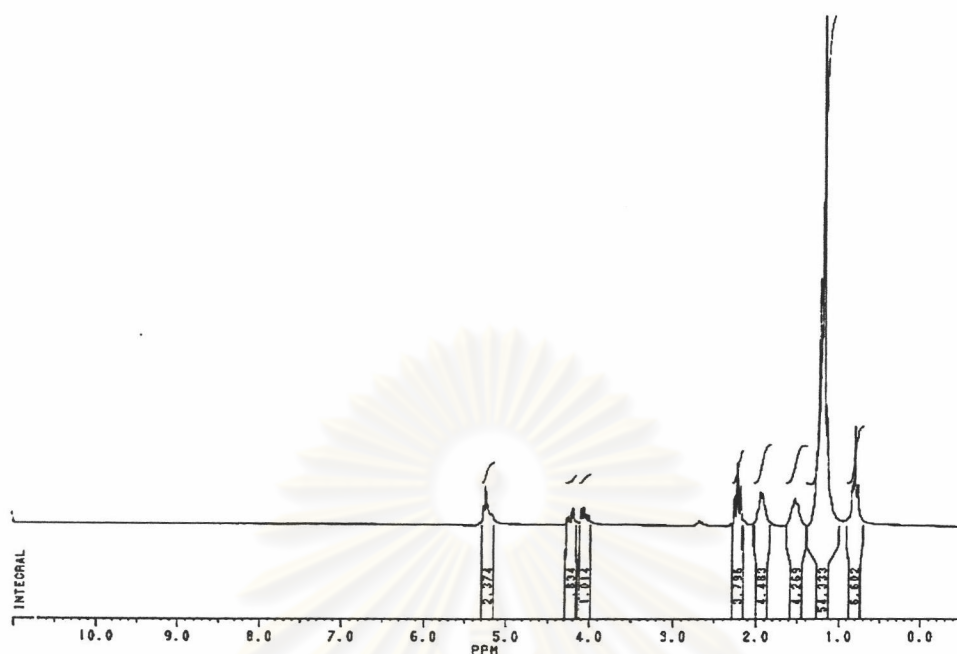


Figure A3 $^1\text{H-NMR}$ Spectrum of Palm Oil (CDCl_3)

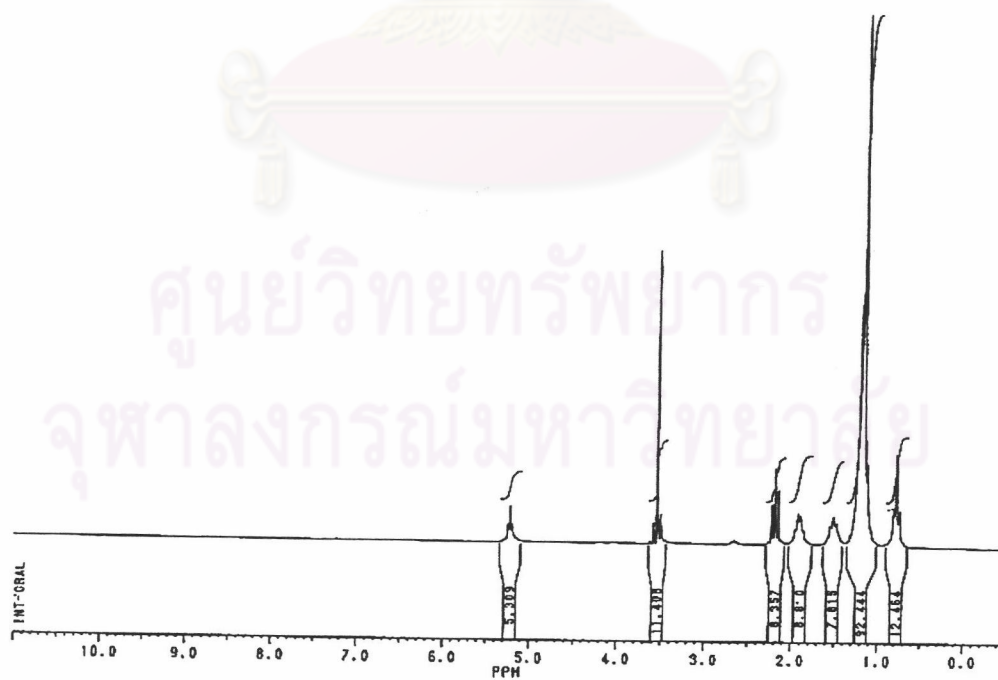


Figure A4 $^1\text{H-NMR}$ Spectrum of Palm Oil Methyl Ester (CDCl_3)

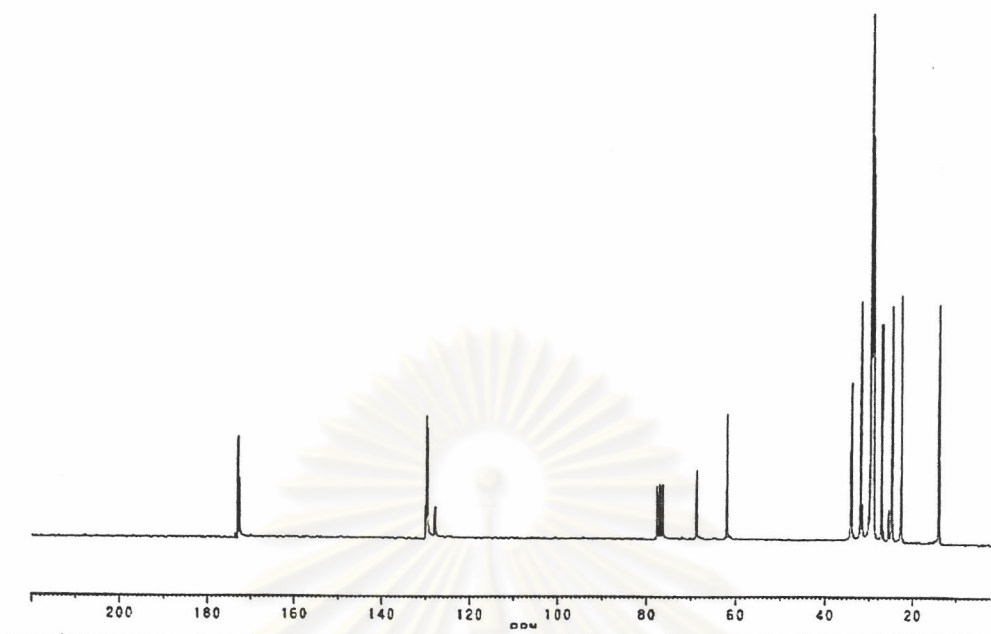


Figure A5 ^{13}C -NMR Spectrum of Palm Oil (CDCl_3)

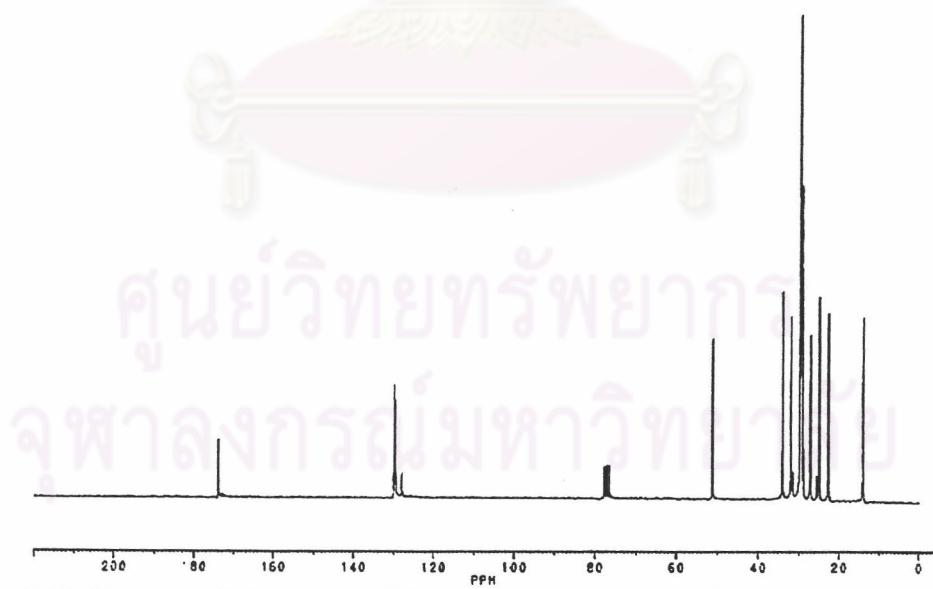


Figure A6 ^{13}C -NMR Spectrum of Palm Oil Methyl Ester (CDCl_3)

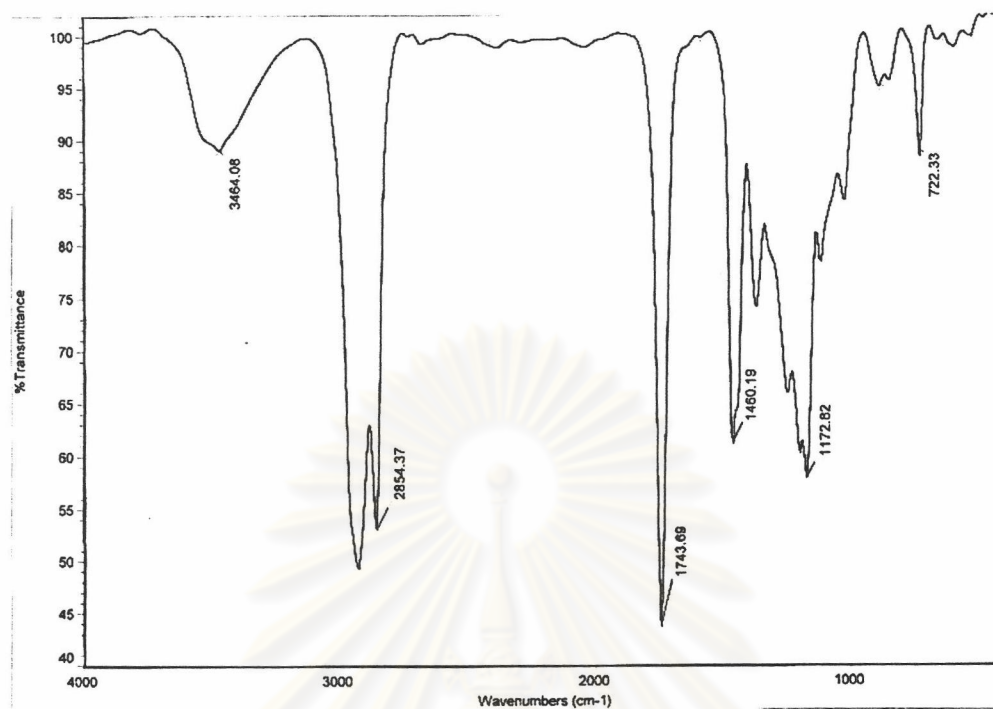


Figure A7 FTIR Spectrum of Palm Oil Epoxide (NaCl)

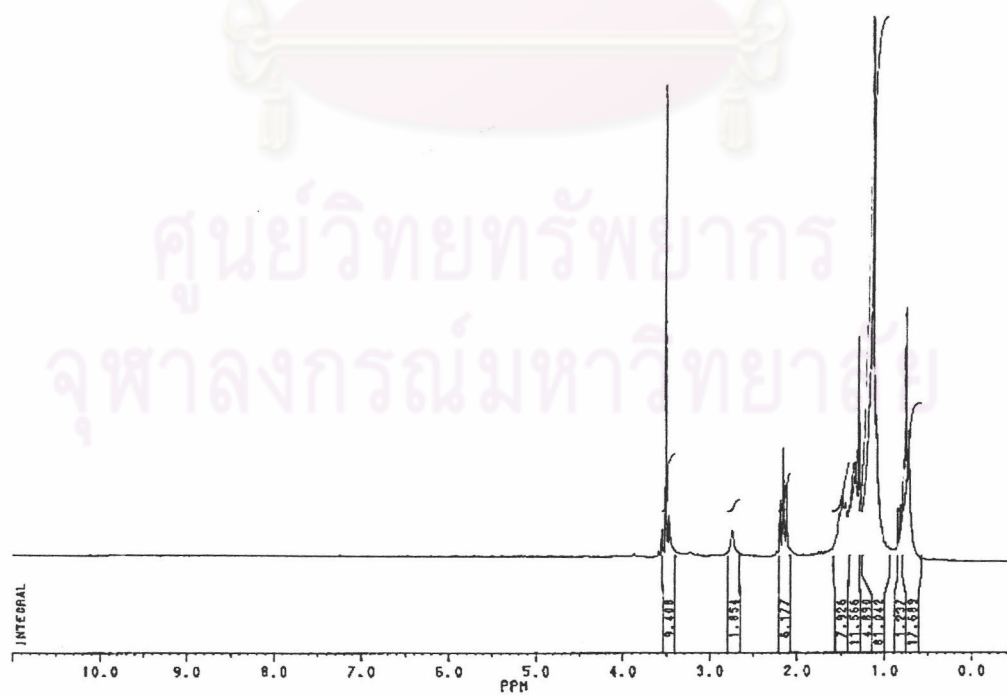


Figure A8 ¹H-NMR Spectrum of Palm Oil Epoxide (CDCl₃)

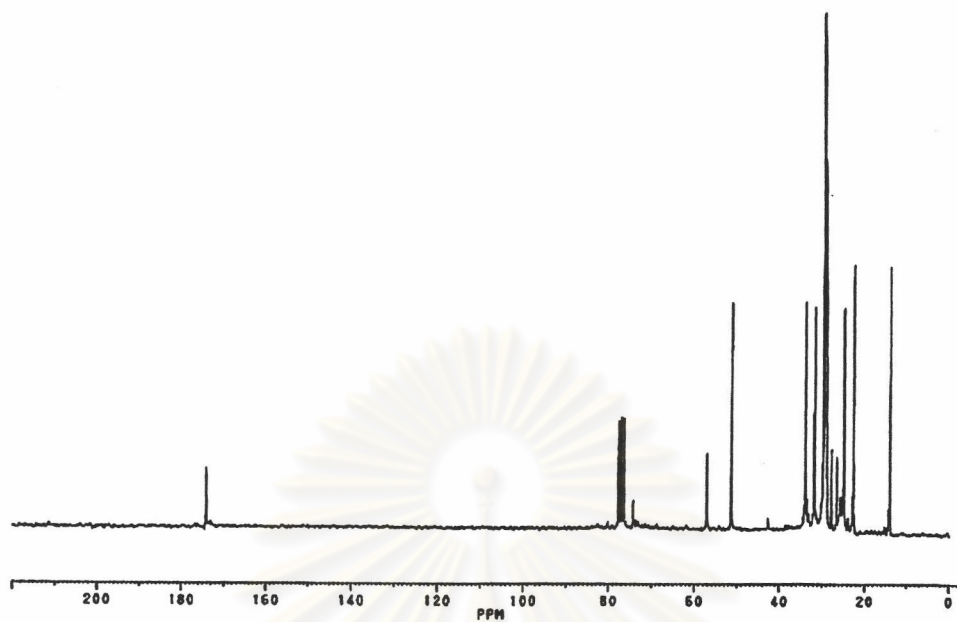


Figure A9 ^{13}C -NMR Spectrum of Palm Oil Epoxide (CDCl_3)

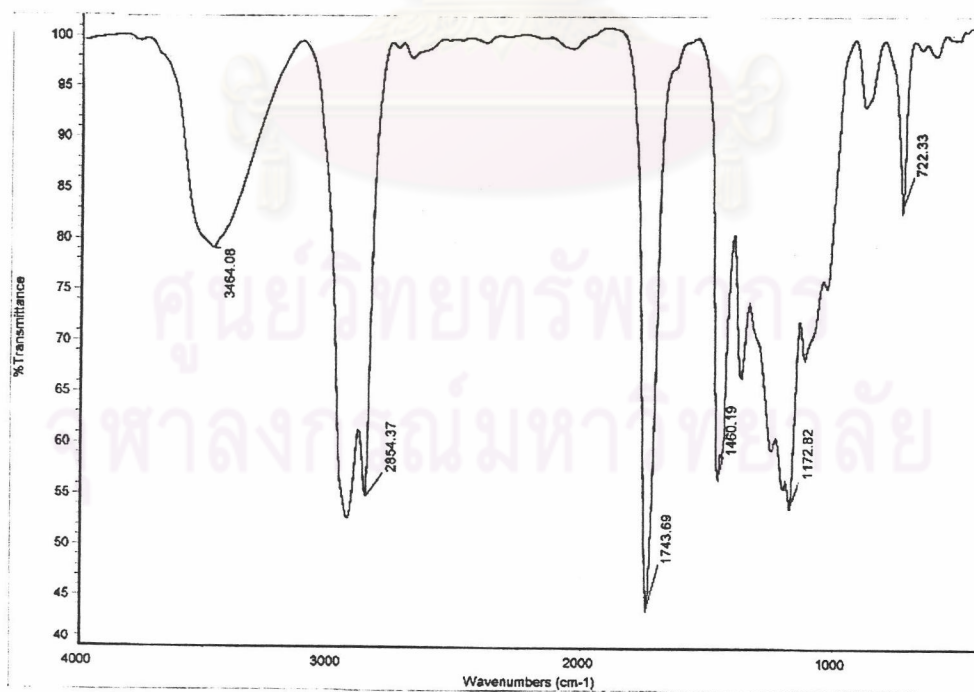


Figure A10 FTIR Spectrum of Palm Oil Diol (NaCl)

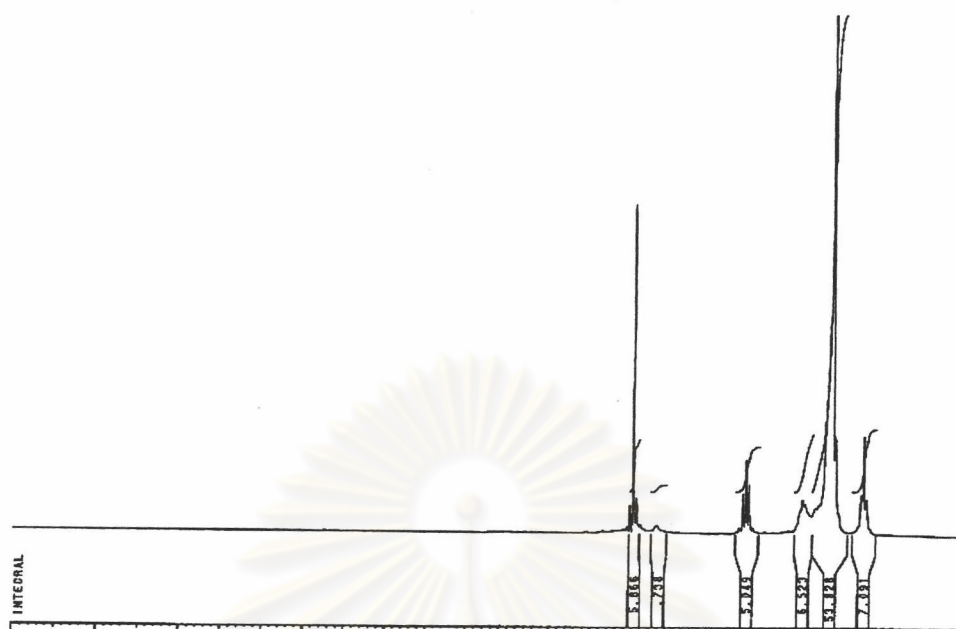


Figure A11 $^1\text{H-NMR}$ Spectrum of Palm Oil Diol (CDCl_3)

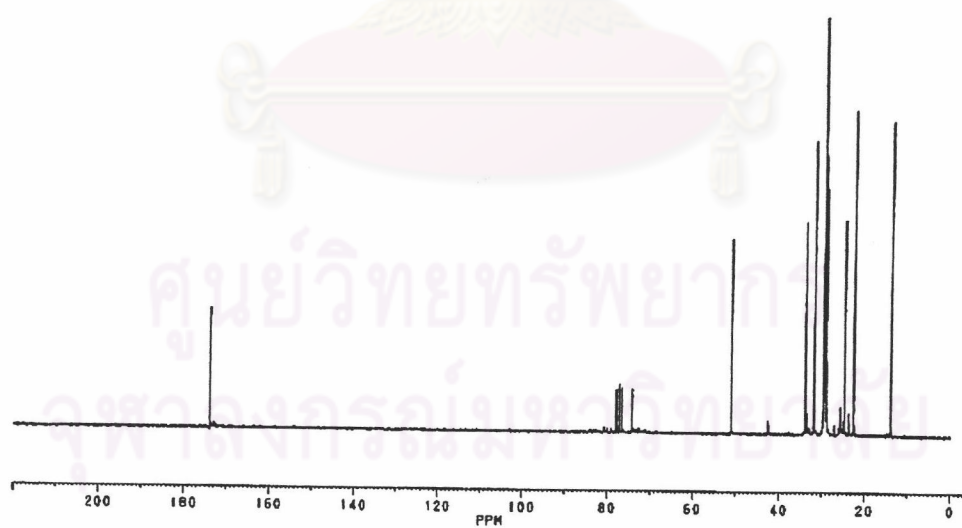


Figure A12 $^{13}\text{C-NMR}$ Spectrum of Palm Oil Diol (CDCl_3)

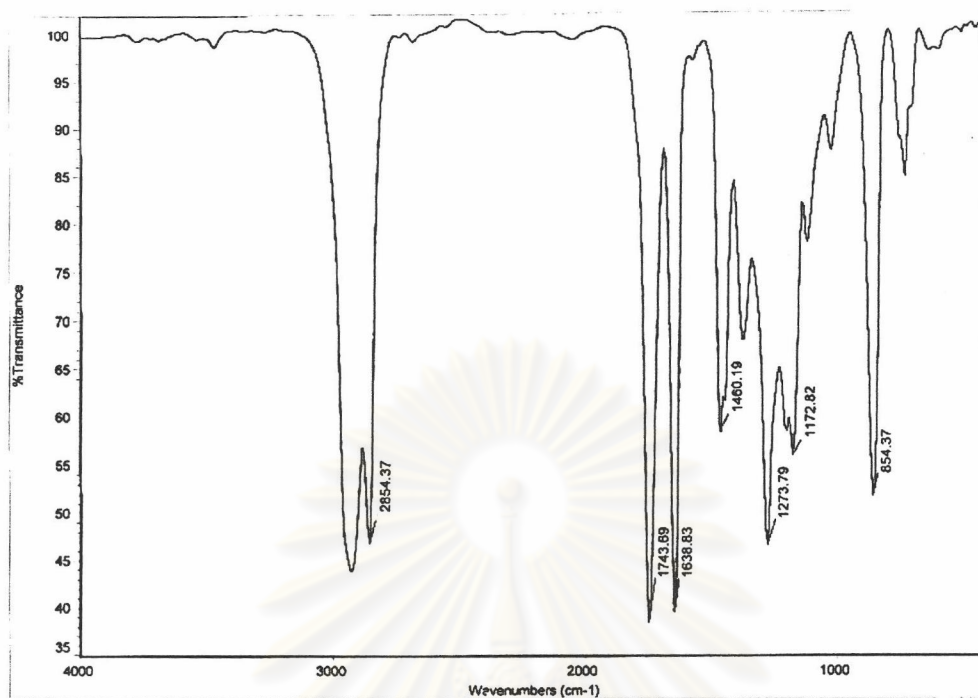


Figure A13 FTIR Spectrum of Palm Oil Nitrate (NaCl)

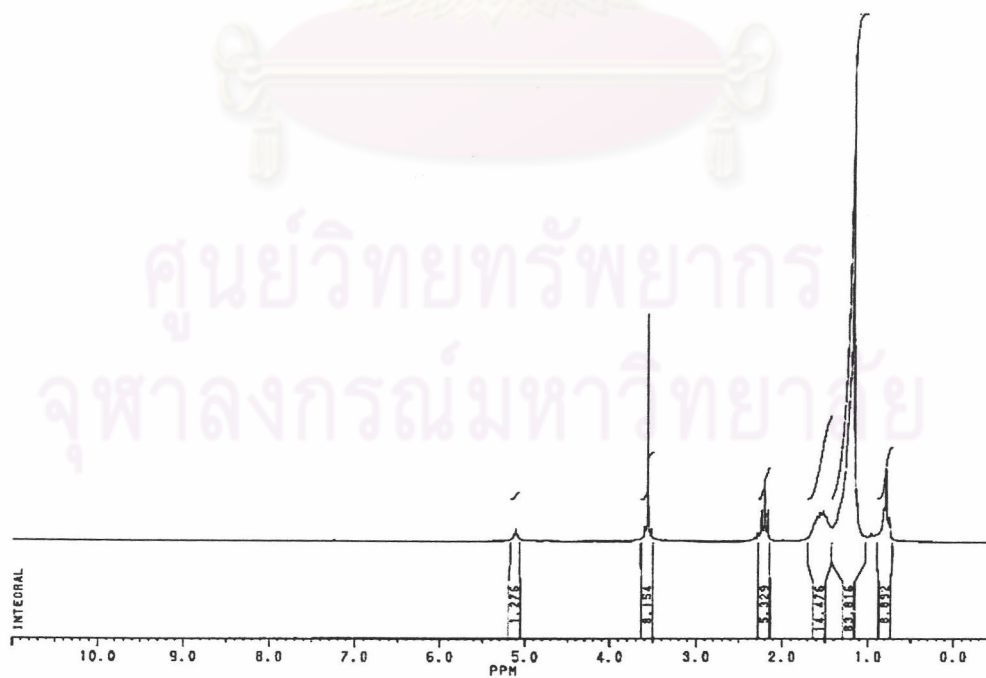


Figure A14 ¹H-NMR Spectrum of Palm Oil Nitrate (CDCl₃)

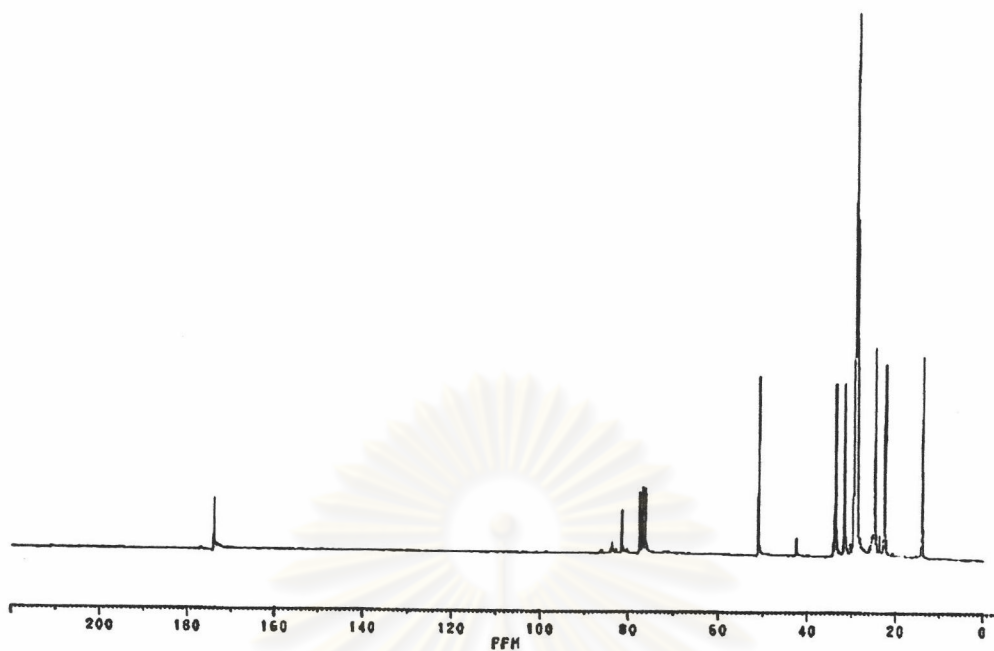


Figure A15 ^{13}C -NMR Spectrum of Palm Oil Nitrate (CDCl_3)

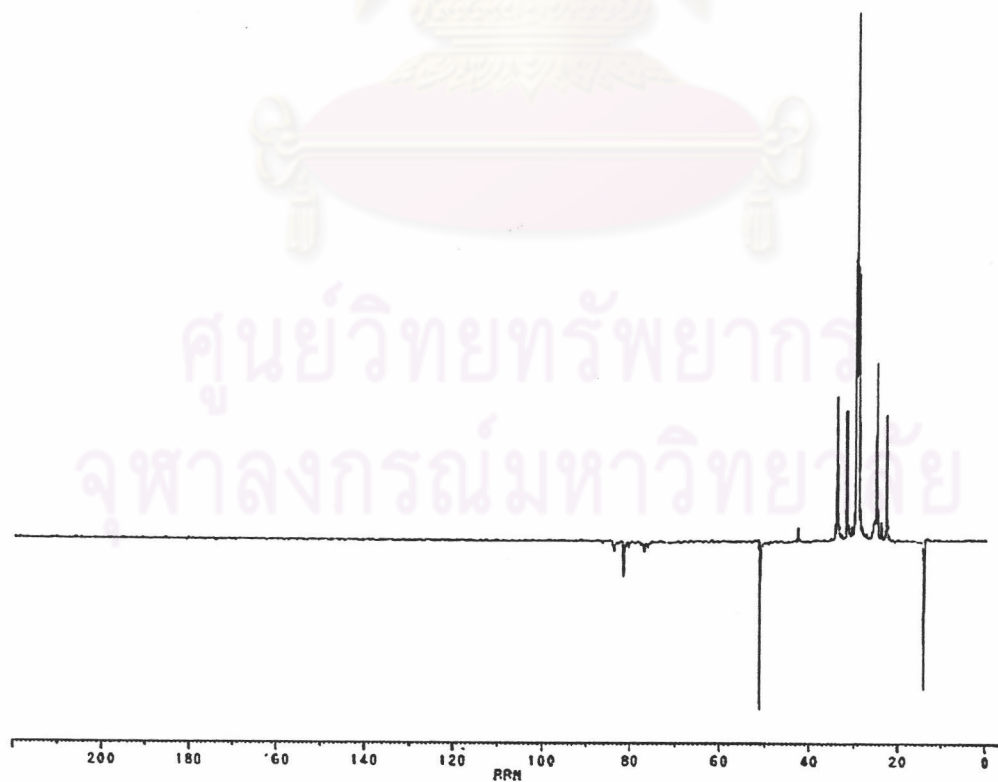


Figure A16 DEPT 135 Spectrum of Palm Oil Nitrate (CDCl_3)

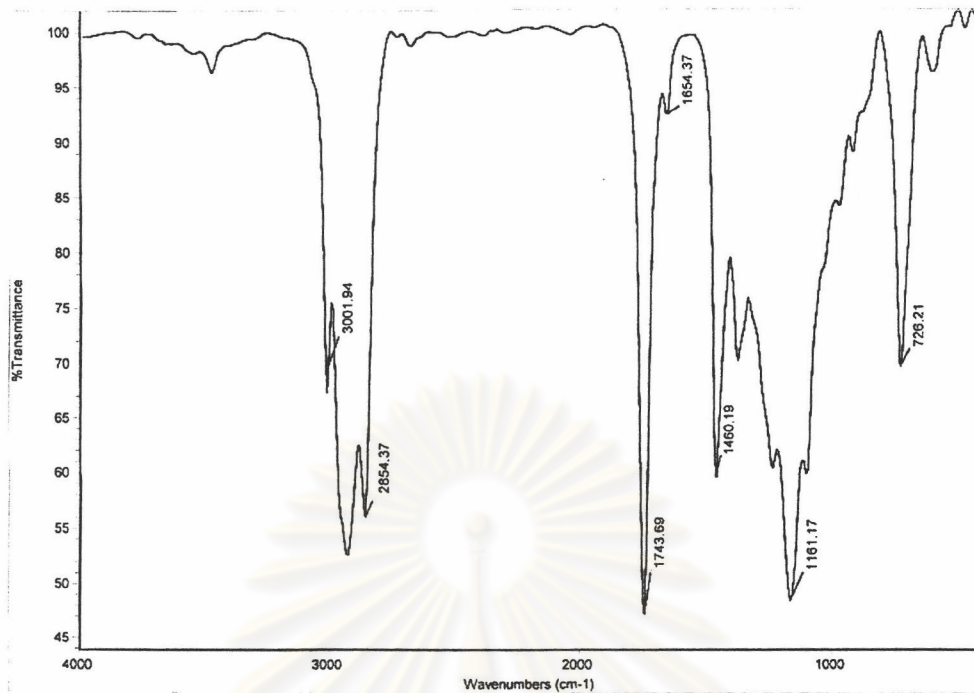


Figure A17 FTIR Spectrum of Soybean Oil (NaCl)

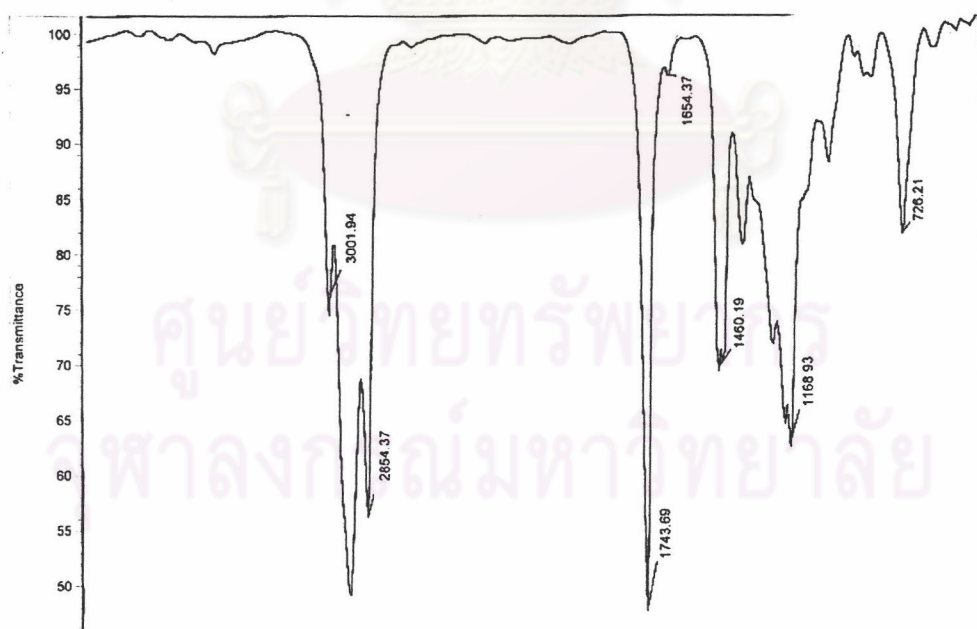


Figure A18 FTIR Spectrum of Soybean Oil Methyl Ester (NaCl)

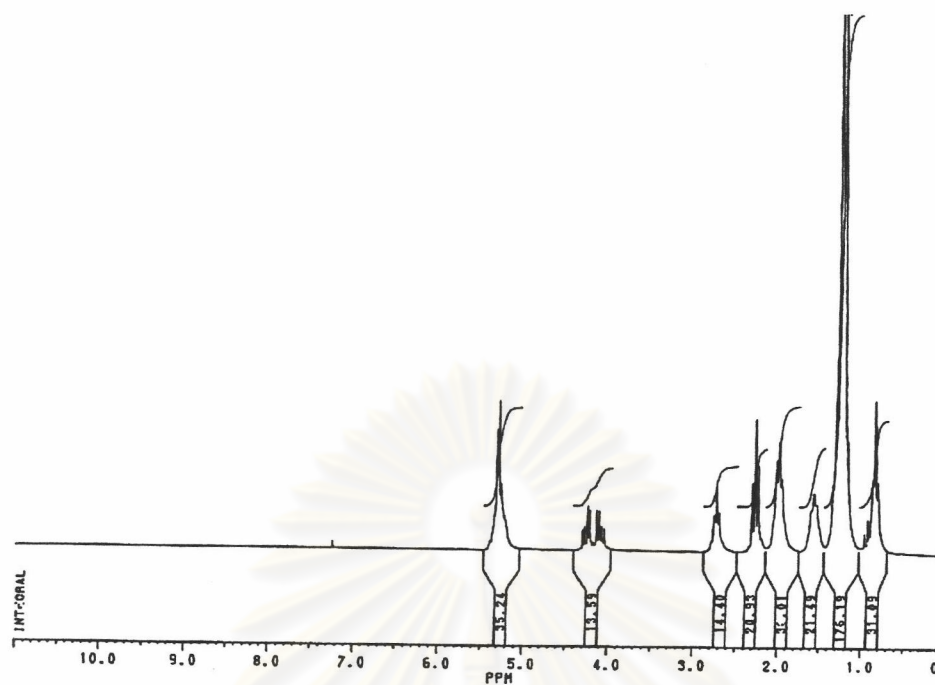


Figure A19 ¹H-NMR Spectrum of Soybean Oil (CDCl₃)

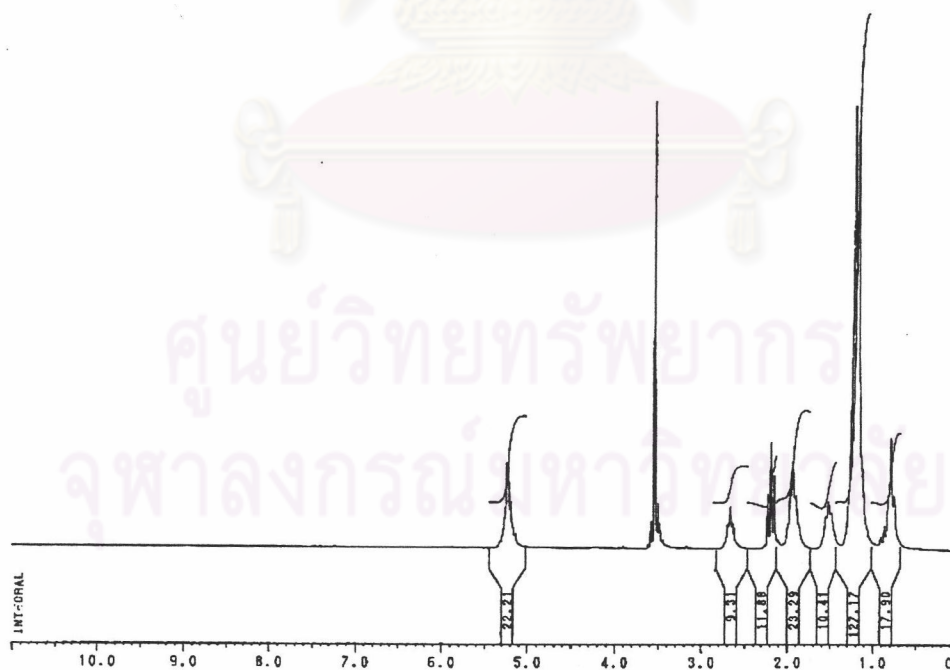


Figure A20 ¹H-NMR Spectrum of Soybean Oil Methyl Ester (CDCl₃)

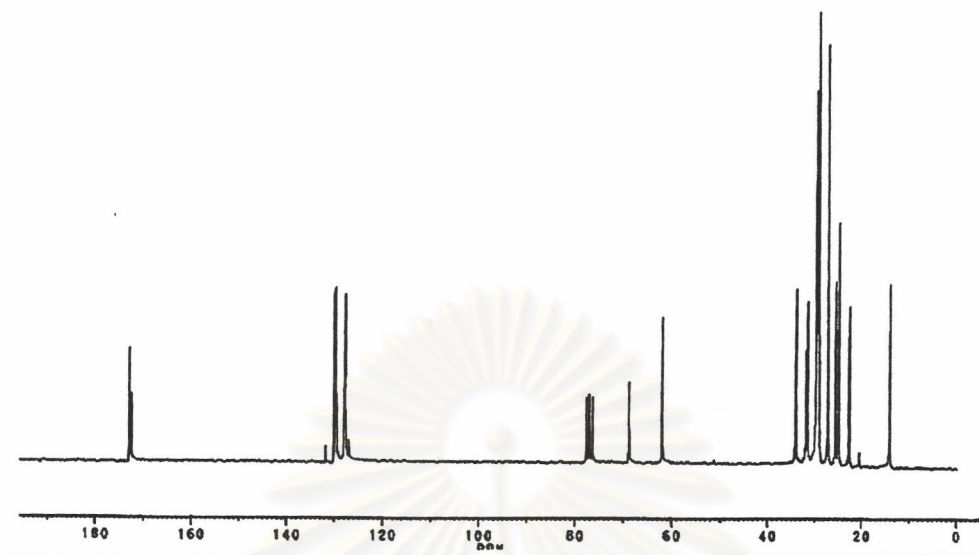


Figure A21 ^{13}C -NMR Spectrum of Soybean Oil (CDCl_3)

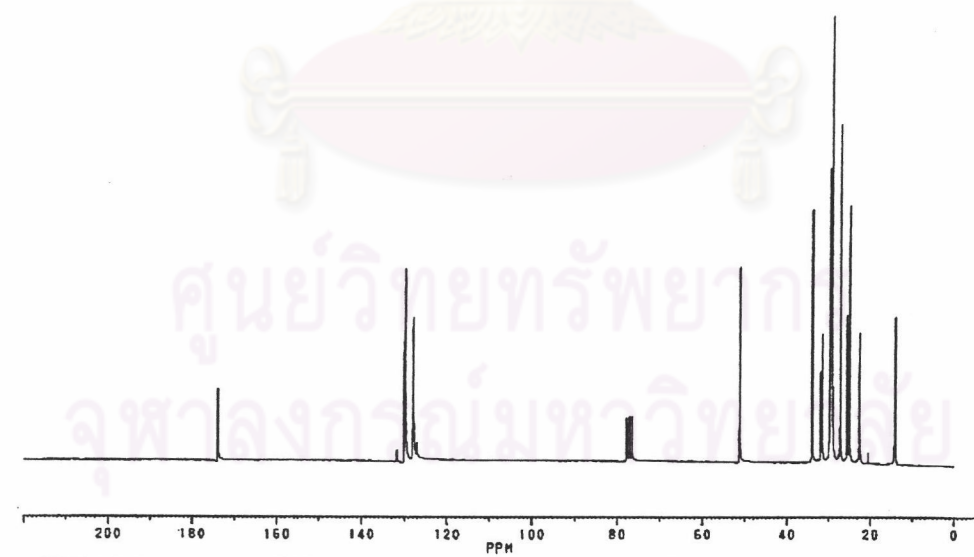


Figure A22 ^{13}C -NMR Spectrum of Soybean Oil Methyl Ester (CDCl_3)

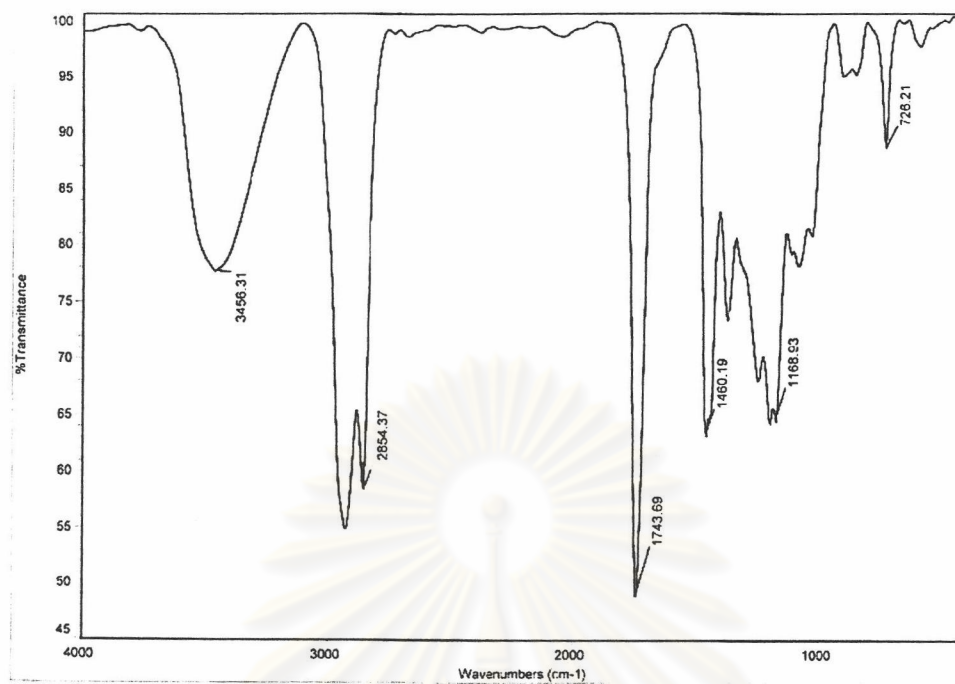


Figure A23 FTIR Spectrum of Soybean Oil Epoxide (NaCl)

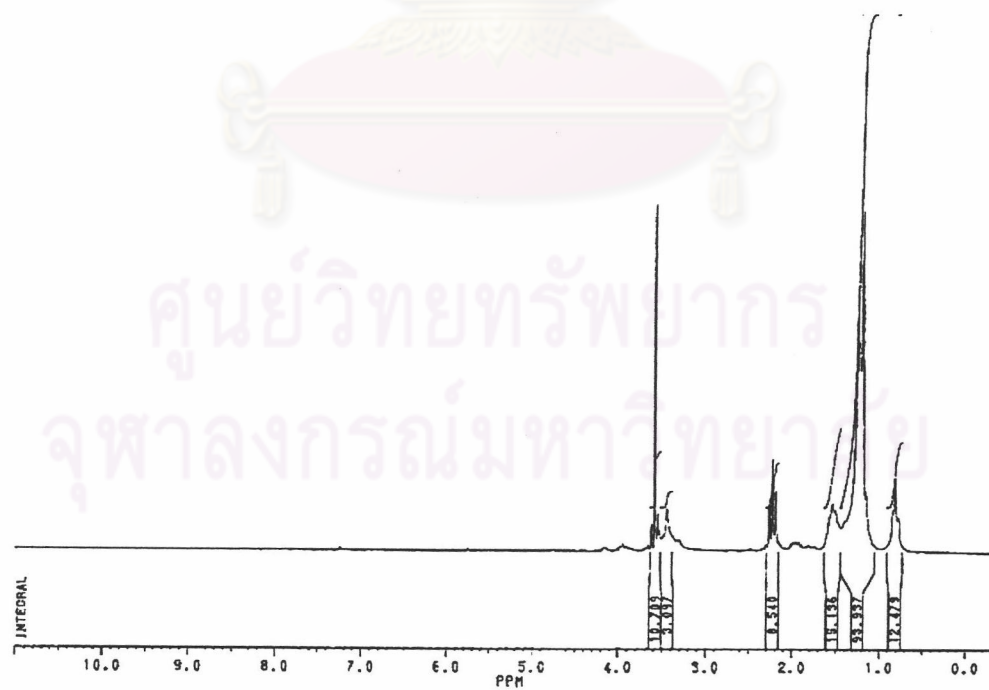


Figure A24 ¹H-NMR Spectrum of Soybean Oil Epoxide (CDCl₃)

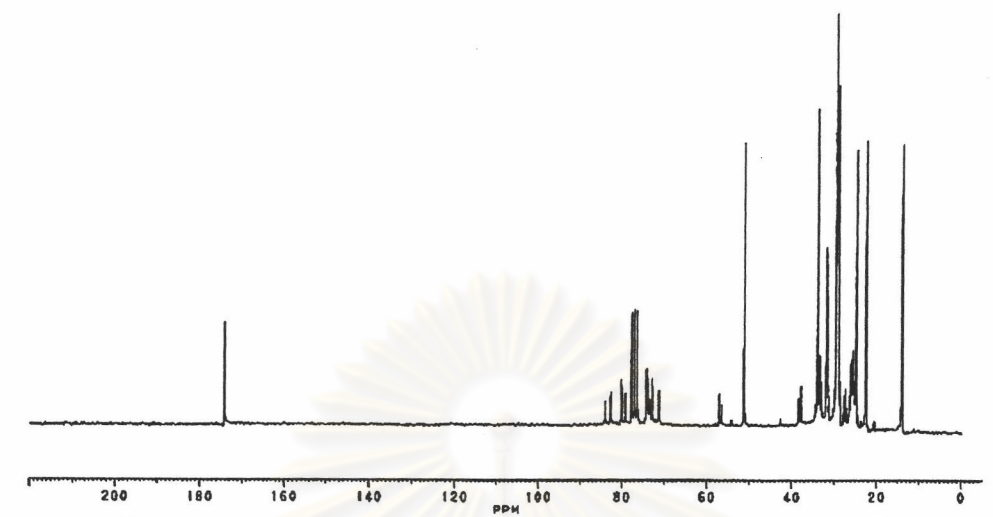


Figure A25 ^{13}C -NMR Spectrum of Soybean Oil Epoxide (CDCl_3)

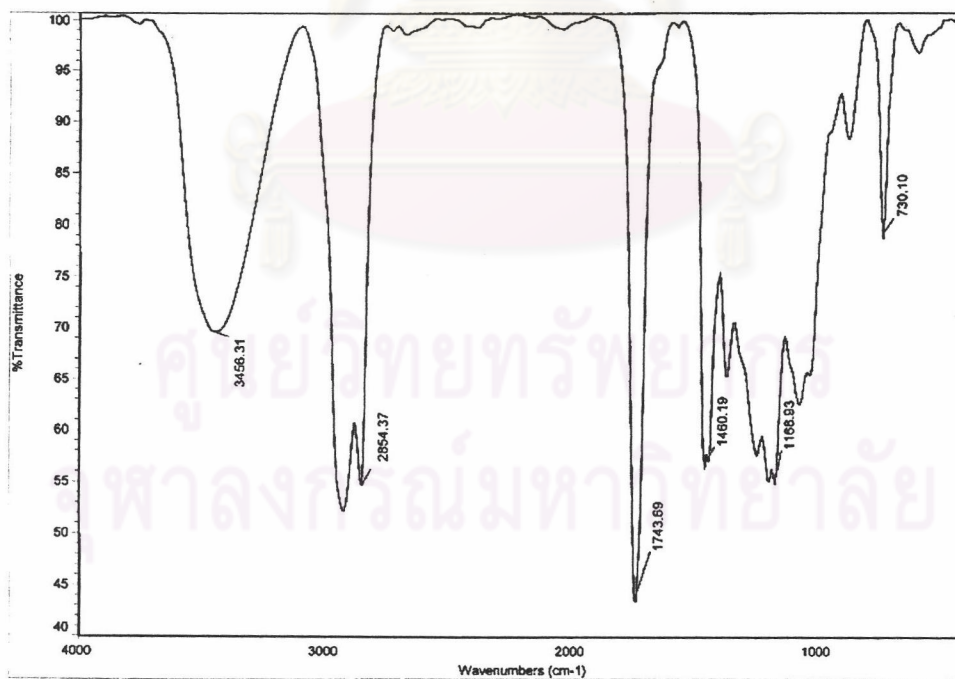


Figure A26 FTIR Spectrum of Soybean Oil Diol (NaCl)

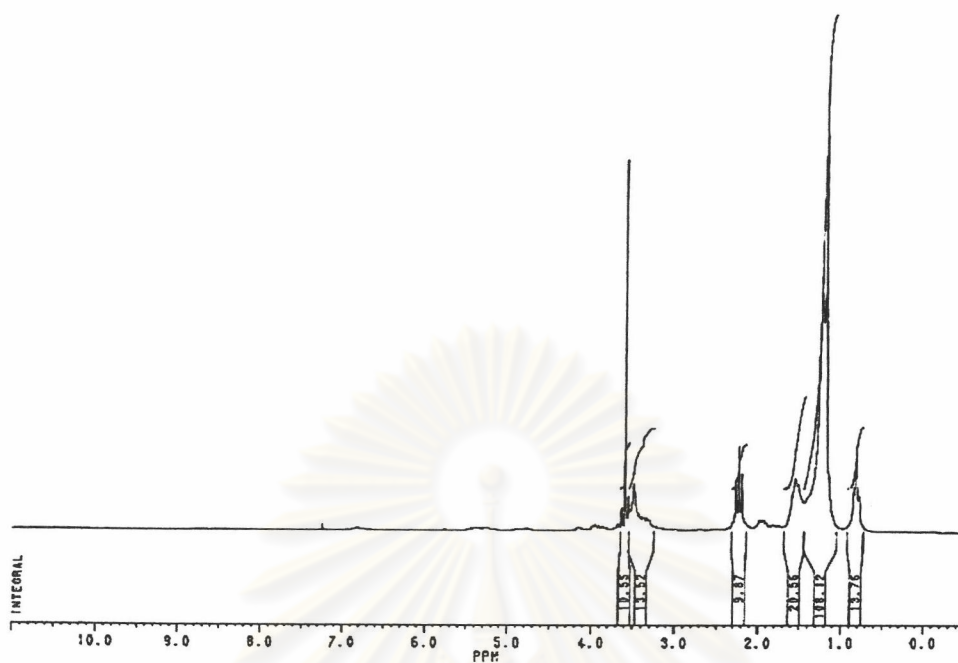


Figure A27 $^1\text{H-NMR}$ Spectrum of Soybean Oil Diol (CDCl_3)

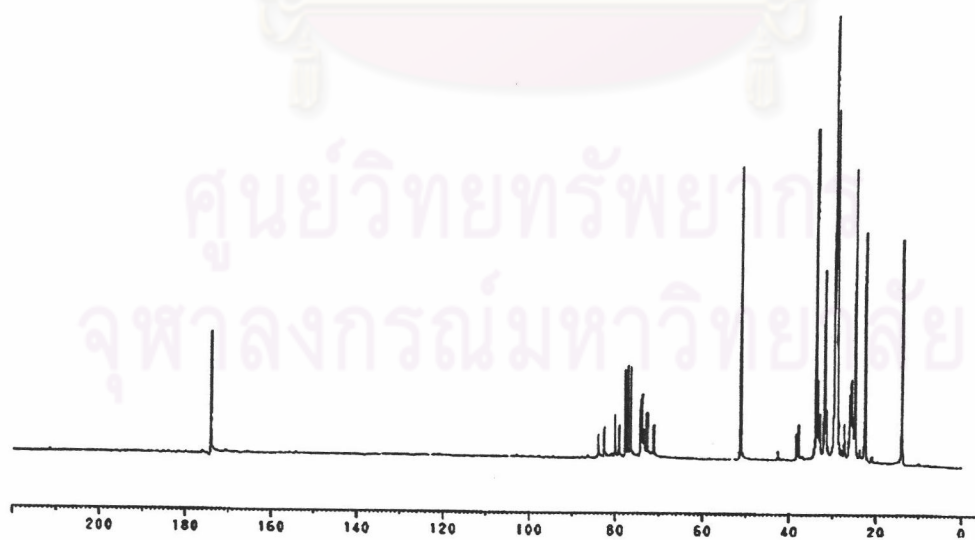


Figure A28 $^{13}\text{C-NMR}$ Spectrum of Soybean Oil Diol (CDCl_3)

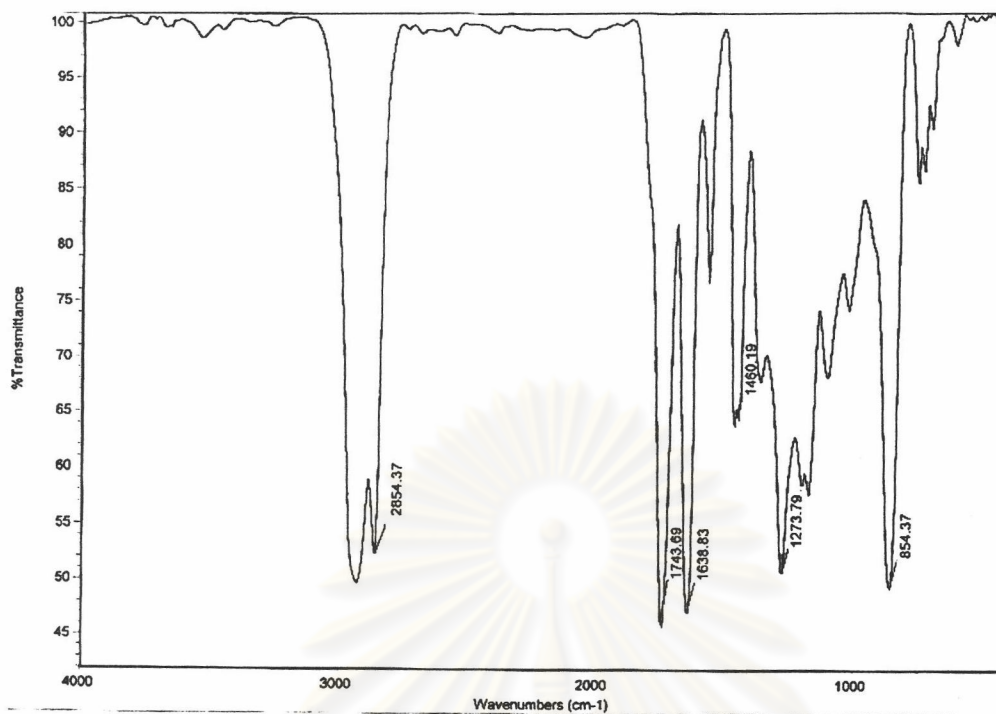


Figure A29 FTIR Spectrum of Soybean Oil Nitrate (NaCl)

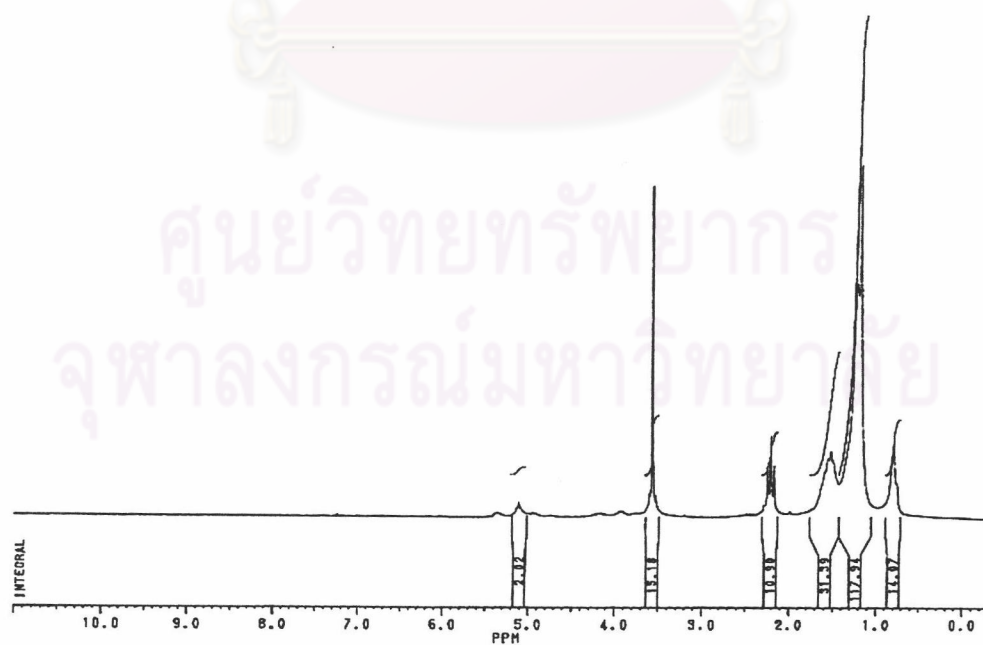


Figure A30 ¹H-NMR Spectrum of Soybean Oil Nitrate (CDCl₃)

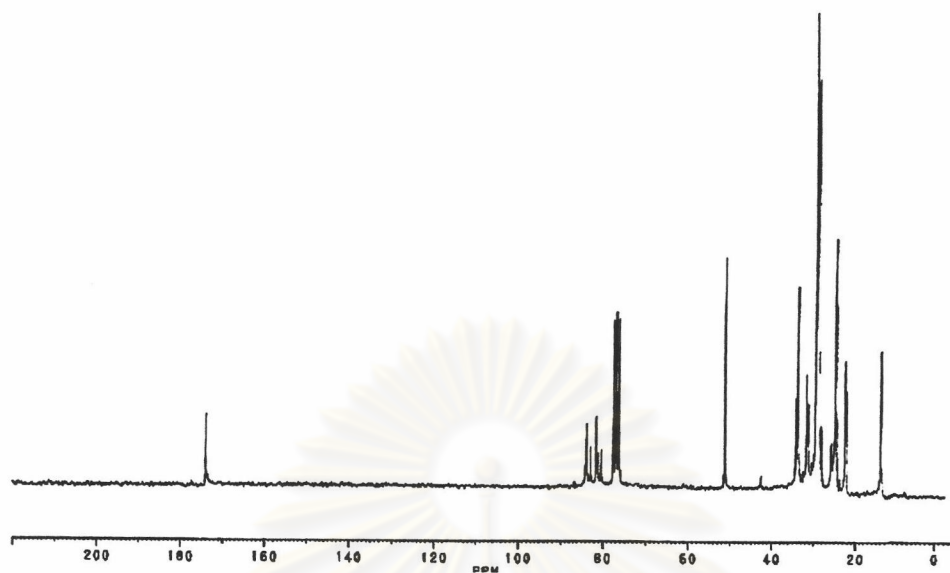


Figure A31 ^{13}C -NMR Spectrum of Soybean Oil Nitrate (CDCl_3)

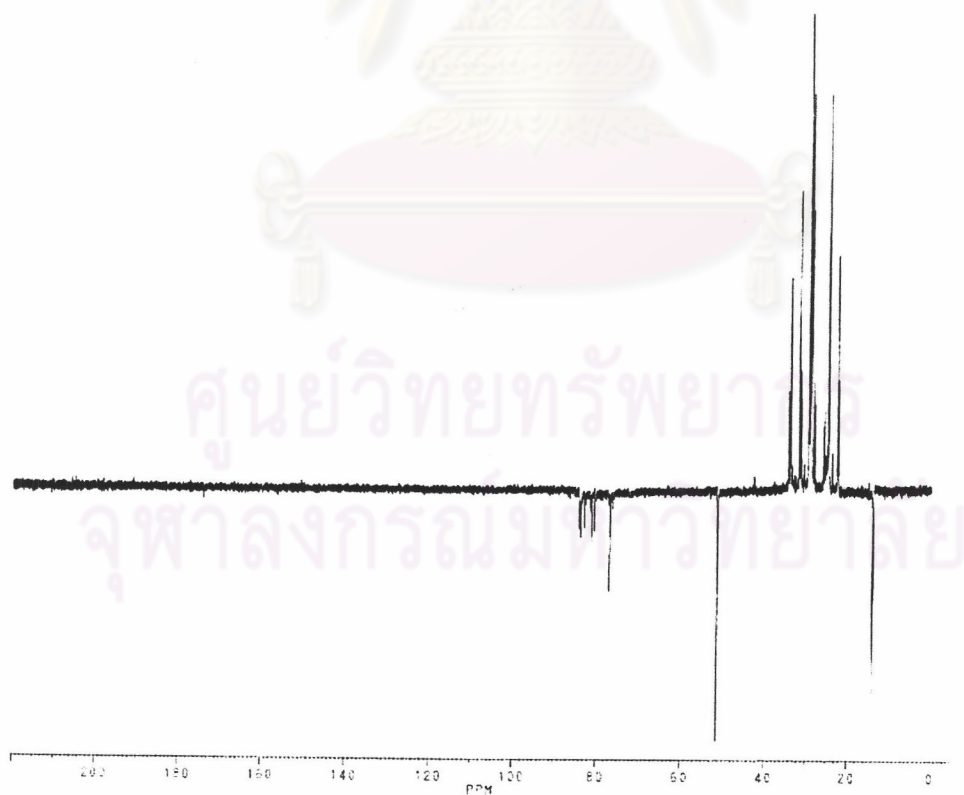


Figure A32 DEPT 135 Spectrum of Soybean Oil Nitrate (CDCl_3)

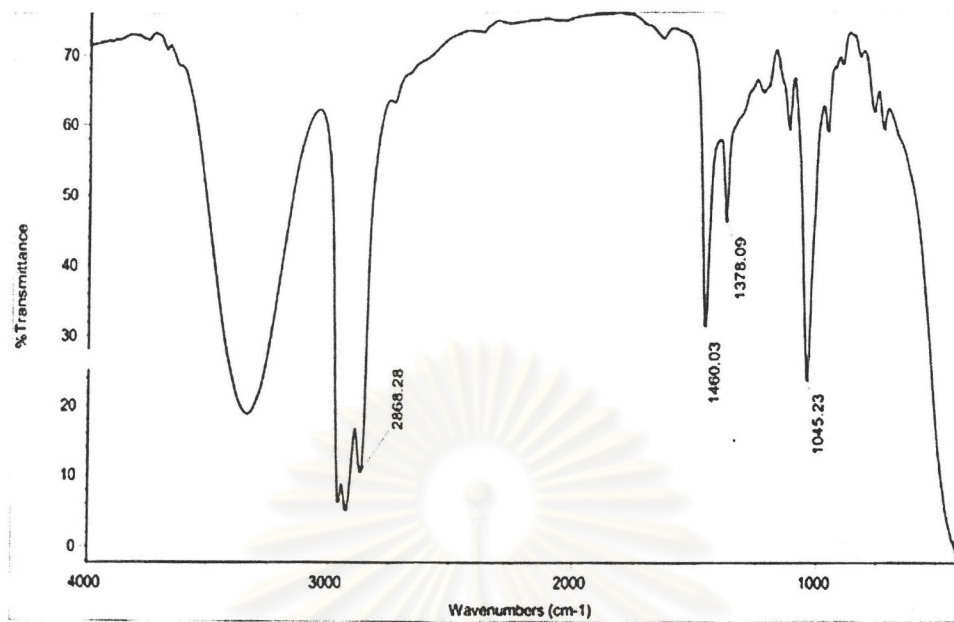


Figure A33 FTIR Spectrum of 2-Ethyl-1-hexanol (NaCl)

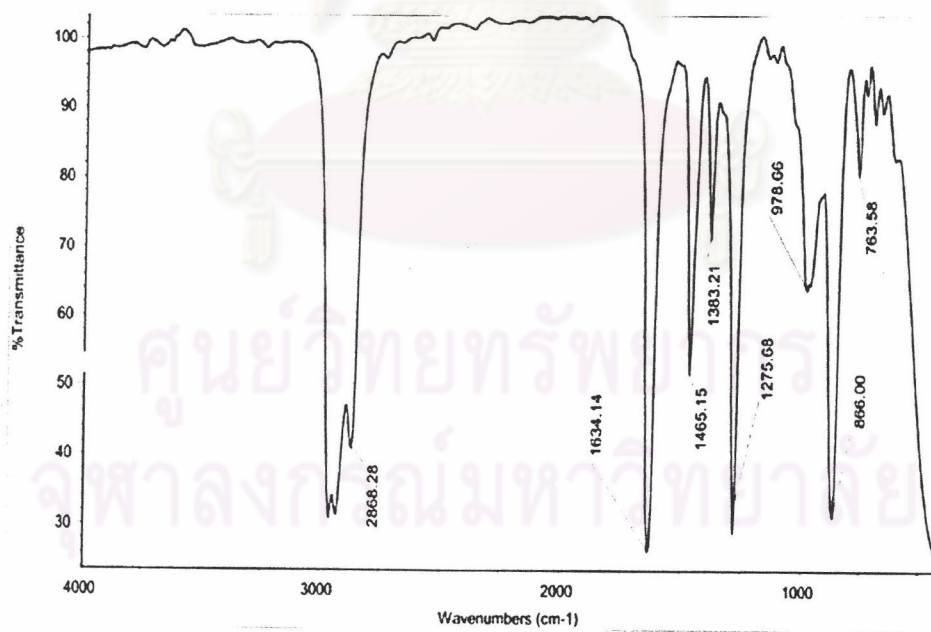


Figure A34 FTIR Spectrum of 2-Ethylhexyl Nitrate (NaCl)

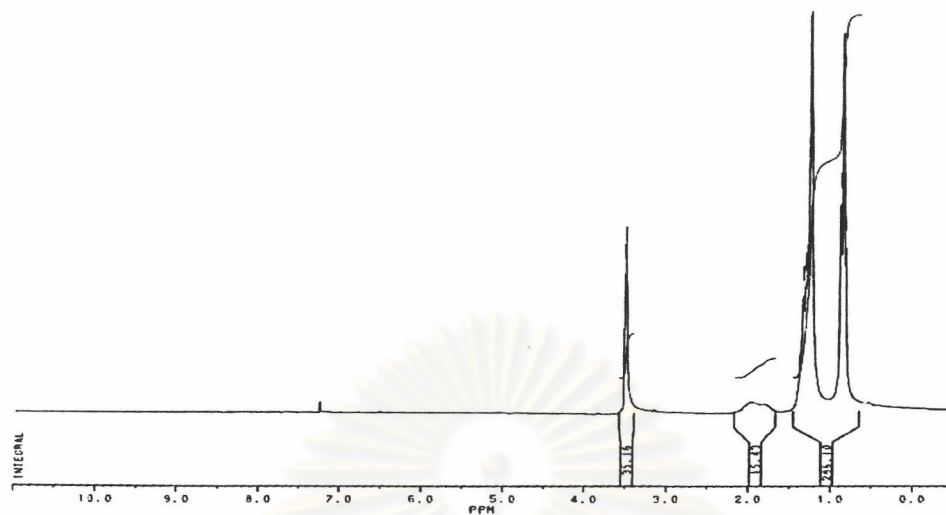


Figure A35 ¹H-NMR Spectrum of 2-Ethyl-1-hexanol (CDCl₃)

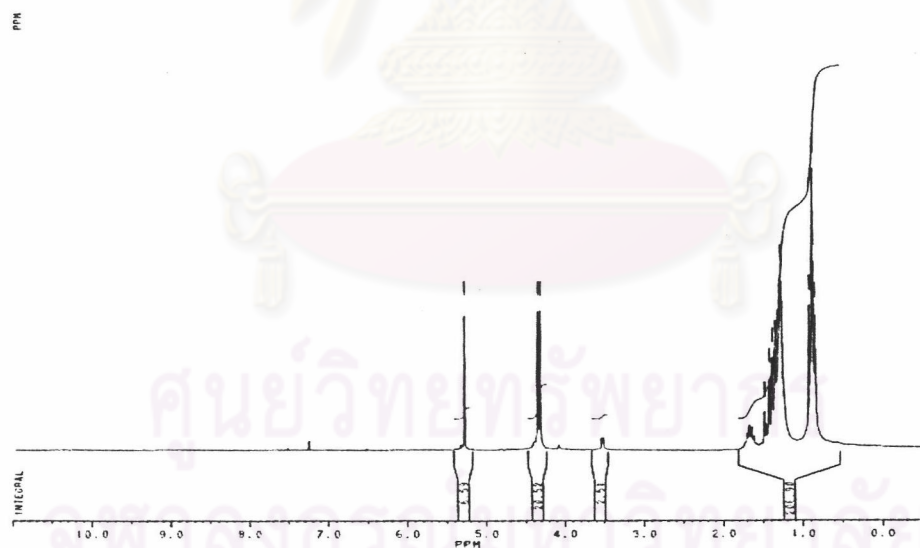


Figure A36 ¹H-NMR Spectrum of 2-Ethylhexyl Nitrate (CDCl₃)

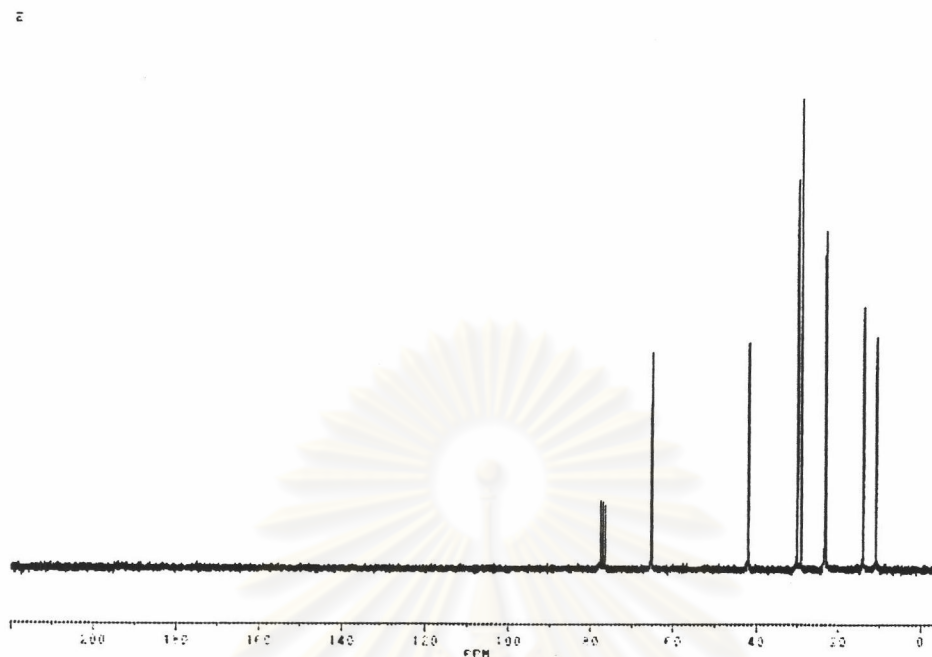


Figure A37 ^{13}C -NMR Spectrum of 2-Ethyl-1-hexanol (CDCl_3)



Figure A38 ^{13}C -NMR Spectrum of 2-Ethylhexyl Nitrate (CDCl_3)

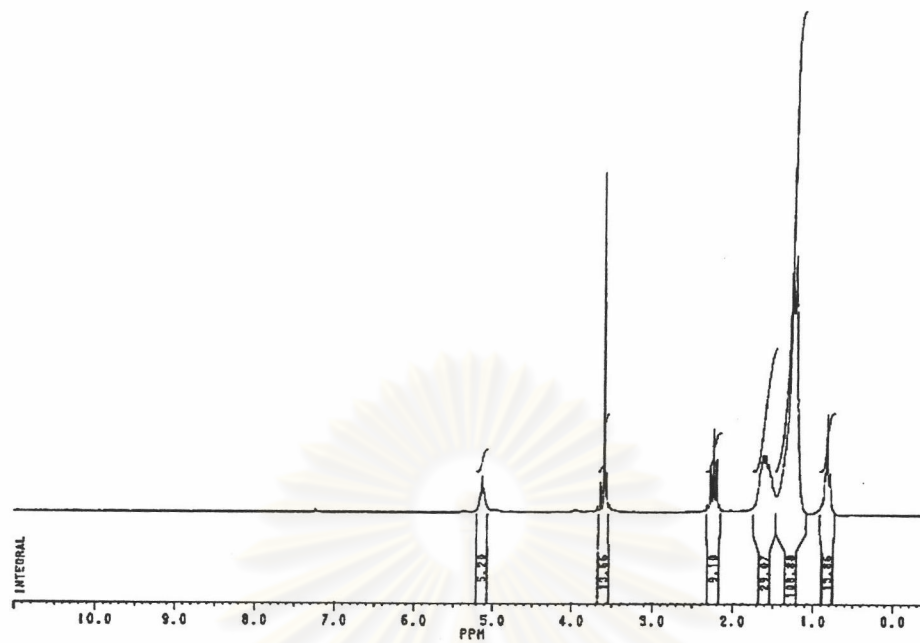


Figure A39 $^1\text{H-NMR}$ Spectrum of Methyl Oleate Nitrate (CDCl_3)

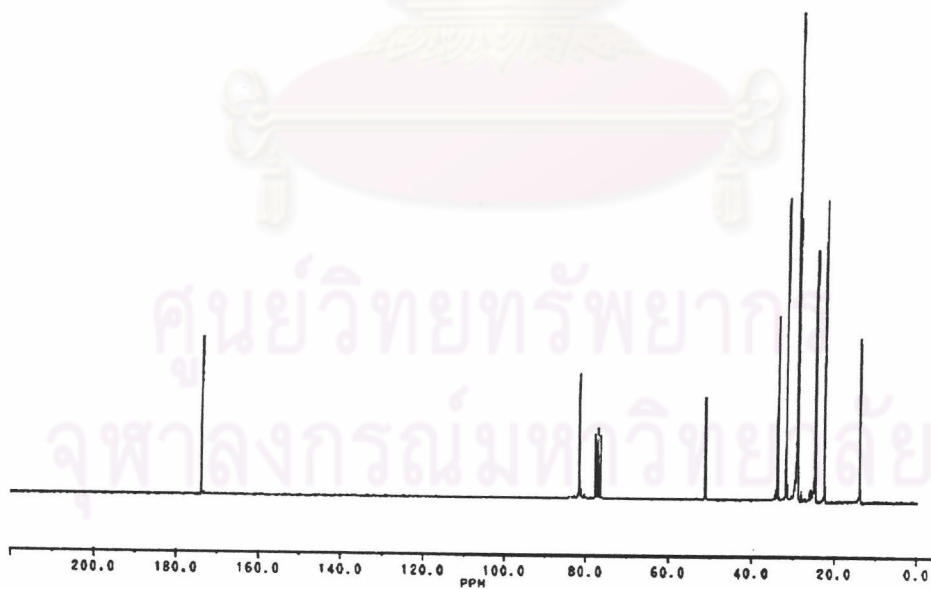


Figure A40 $^{13}\text{C-NMR}$ Spectrum of Methyl Oleate Nitrate (CDCl_3)

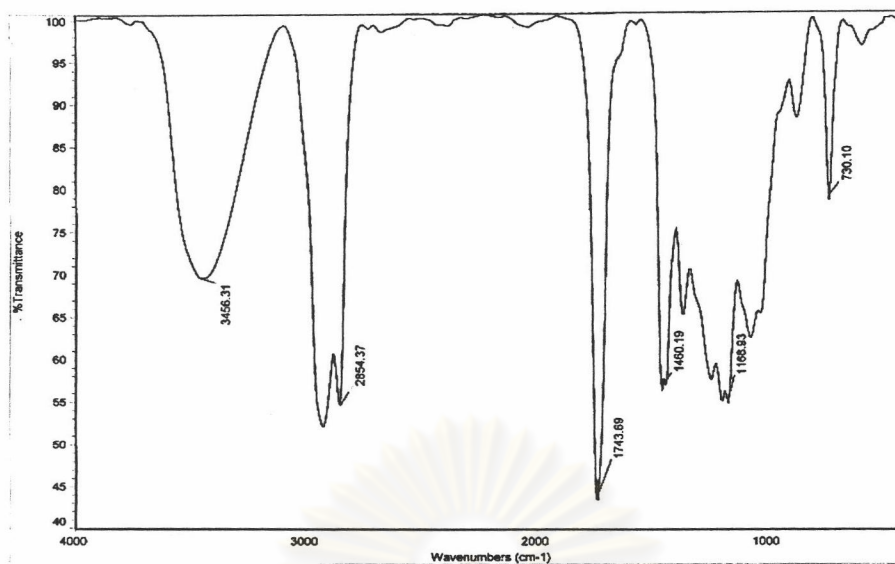


Figure A41 FTIR Spectrum of starting diol compound (NaCl).

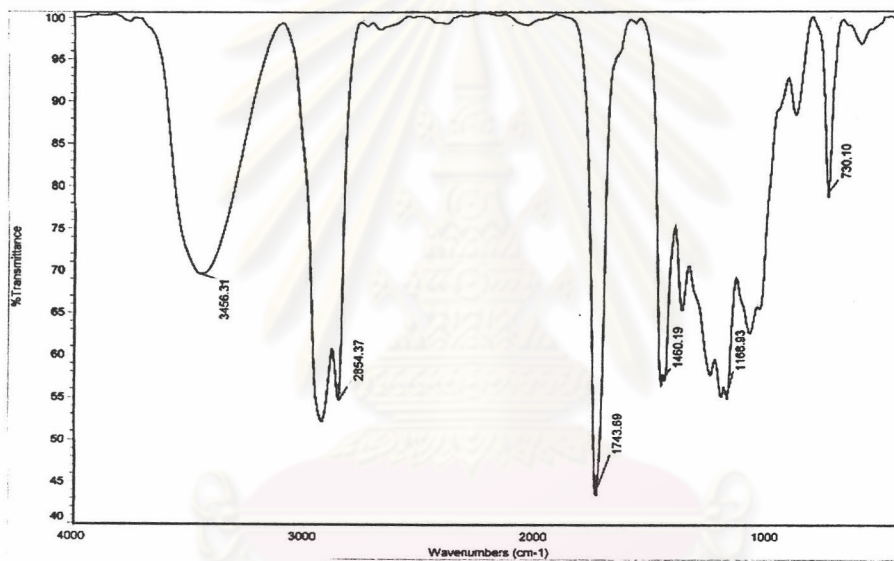


Figure A42 FTIR Spectrum of no nitration reaction (NaCl).

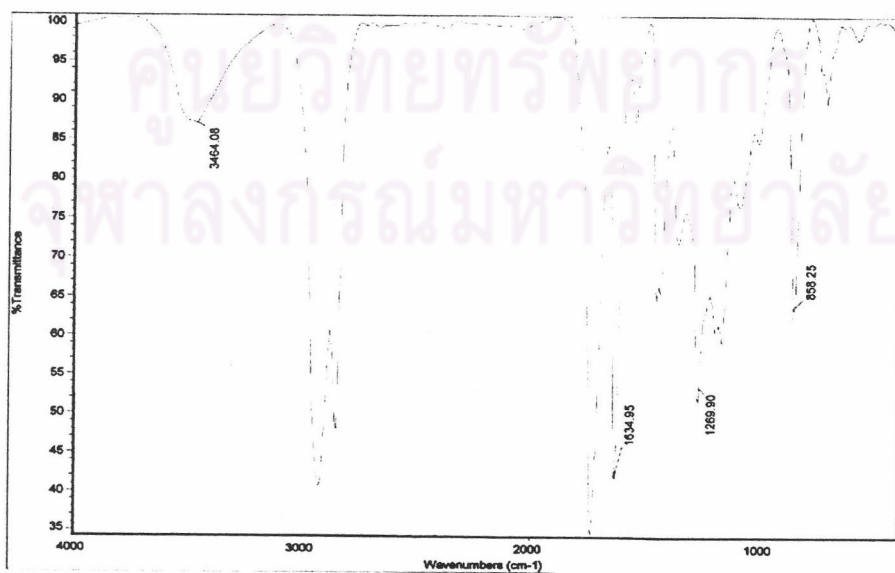


Figure A43 FTIR Spectrum of incomplete nitration reaction (NaCl).

APPENDIX B

SPECIFICATION AND TEST METHOD FOR DIESEL

FUEL IN THAILAND

| Characteristics | Specification | | |
|-----------------------------------|---|------------------|-------------|
| | High-Speed Engine | Low-Speed Engine | Methods |
| Density at 15.6/15.6°C | 0.81-0.87 | 0.92 | ASTM D1286 |
| Cetane Number | min 47 | min 45 | ASTM D 613 |
| Or Calculated Cetane Index | min 47 | min 45 | ASTM D 976 |
| Viscosity at 40°C, cSt | 1.8-4.1 | max 8.0 | ASTM D 445 |
| or at 50°C, cSt | | max 6.0 | |
| Pour Point, °C | max 10 | max 16 | ASTM D 97 |
| Sulfur Content, %wt. | max 0.25 | max 1.5 | ASTM D 129 |
| Copper Strip Corrosion, number | max 1 | - | ASTM D 130 |
| Carbon Residue, %wt. | max 0.05 | - | ASTM D 189 |
| Water and Sediment, %vol. | max 0.05 | max 0.3 | ASTM D 2709 |
| Ash Content, %wt. | max 0.01 | max 0.02 | ASTM D 482 |
| Flash Point, °C | min 52 | min 52 | ASTM D 93 |
| Distillation | max 357 | - | ASTM D 86 |
| (temperature of 90% distillation) | | | |
| Color | max 4.0 | - | ASTM D 1500 |
| Detergent Additive | Test by the Standard CUMMINS Tandem L-10 (Superior Level) | - | - |

VITA

Chayaporn Pongthanomsak was born on August 11, 1980 in Suratthani, Thailand. He received his Bachelor's Degree of Science in Chemistry from Chiang Mai University in 2001. He continued his Master's Degree of Science in Petrochemistry and Polymer Science, Faculty of Science, Chulalongkorn University and graduated in 2004.



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