REFERENCES

1. วีระศักดิ์ ธนาพรสิน. การผลิตน้ำมันหล่อลื่นพื้นฐานจากน้ำมันเตาใสเบาและน้ำมันเตาใสหนักโดยกระบวนการแยกไขด้วยตัวทำละลายและกระบวนการสกัดด้วยตัวทำละลาย. วิทยานิพนธ์ปริญญามหาบัณฑิต จุฬาลงกรณ์มหาวิทยาลัย, 2536.

2. Hobson, G.D. Morden Petroleum Technology. 5th ed. London: John Wiley & Sons, pt.2, pp.426-430,782-786, pt.3, pp.1091-1096, 1984.

3. Billon, A., and Periers, J.P. Improvements in Waxs and Special Oil Refining. Proceeding American Petroleum Institute, Refining Department. 59(May1980):168-177.

4. ศศิวิมล บุญทรง. การปรับปรุงคุณภาพส่วนกลั่นหนักเพื่อใช้เป็นน้ำมันหล่อลื่นพื้นฐานโดยกระบวนการบำบัดด้วยไฮโดรเจน. วิทยานิพนธ์ปริญญามหาบัณฑิต จุฬาลงกรณ์มหาวิทยาลัย, 2536.

5. Elvers, B. ULLmann's Encyclopedia of Industrial Chemistry. 5th ed. Germany: John Wiley & Sons, Vol. A15, pp. 428-432, 1990.

6. Wills, J.G. Lubrication Fundamental. New York: Mobil Oil Cooperation, Marcel Dekker Inc., pp. 34-40, 1990.

7. Annual Book of ASTM Standards. ASTM D 156, pt.23, 1982.

8. Annual Book of ASTM Standards. ASTM D 1500, pt.24, 1982.

9. Annual Book of ASTM Standards. ASTM D 2008, pt.24, 1982.

10. Annual Book of ASTM Standards. ASTM D 2269-73, pt.24, 1982.

11. Annual Book of ASTM Standards. ASTM D 565, pt.23, 1982.

12. ปราโมทย์ ไชยเวช. ปิโตรเคมีเทคโนโลยี. ภาควิชาเคมีเทคนิค คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย, 2533.

13. Motier, R.M., and Orszulik, S.T. Chemistry and Technology of Lubricants. Blackie and Sons Ltd., 1992.

14. Martar, S., Mirbach, M.J., and Tayim, H.A. Catalysis in Petrochemical Process. Netherlands: Kluwer Academic Publishers,1989.

15. Asseff, D.A. Lubrication Theory and Practice. Ohio: The Lubrizol Co., pp. 4-6, 1988.

16. Mcketta, J.J. Encyclopedia of Chemical Processing and Design. New York: Marcel Dekka Inc., Vol.28, pp. 351-333,1998.

17. โรงกลั่นน้ำมันฝาง-ทรัพยากรทางเหนือ. วารสารไทยออย์ 3 (กันยายน 2531):13-15.

18. Horne, W.A., and McAfee, J. Principal Reactions of Hydrocarbons. Advances in Petroleum Chemistry and Refining. New York: Intersicence, Vol.3, Chap.5, pp. 211-213,1965.

19. Satterfield, C.N. Heterogeneous Catalysis in Practice. McGrow-Hill Book Company,1980.

20.Gates, B.C. Catalytic Chemistry. Singapore: John Wiley & Son, Inc., pp. 396-403,1992.

21. Kemball, C. Catalysis. London: Billing & Son Limited, Vol.1 , pp. 205-233,1977.

22. Emmett, P.H. Catalysis. USA.: The Waverly Press, Inc., Vol.V, pp.405-526,1959.

23. Nebesh, E., Plundo, R.A., and McMahon, S.L. Hydrotreating Catalyst and Process. US 4,957,895. 1990.

24. Chang-Yu Yu, and Froment, G.F. Rate Equations for the Modeling of the Synergy in Multicomponent Catalysts with Interconversion of Active Sites. Chemical Engineering Science Vol.46, No. 12, pp. 3177-3188, 1991.

25. Rausch, M.K., Erickson, H., and Tollefsen, G.F. White Mineral Oil Made by Two Stage Hydrogenation. US 4,251,347. 1981.

APPENDIX

26. Carey, F.A., and Sundberg, R. Advanced Organic Chemistry. New York: Plenum Press, pt. B, pp. 73-76, 1977.

27. Rausch, M.K. Making a White Oil by Two Stages of Catalytic Hydrogenation. US. 3,457,656. 1969.

28. William, W.W. Process to make Technical White Oil. US. 4,072,603. 1978.

29. Kidwell, L.E. Two-Stage Process for Manufacture of White Oils. US. 4,055,481. 1989.

30. Brandes, K.K., Kukes, S.G., and Davis, T. Impregnated Alumina-Containing Material US. 4,831,004. 1989.

31. Poncelet, G., Jacobs, P.A., Grange, P., and Delmon, B. Preparation of Catalyst Netherlands: Elsevier Science Publishers B.V., pp.611-616, 1991.

32. Copy, I.A., and Broun, D.L. Upgrading Waxy Distillate and Raffinates and Hydroisomerization. US. 4,992,159. 1991.

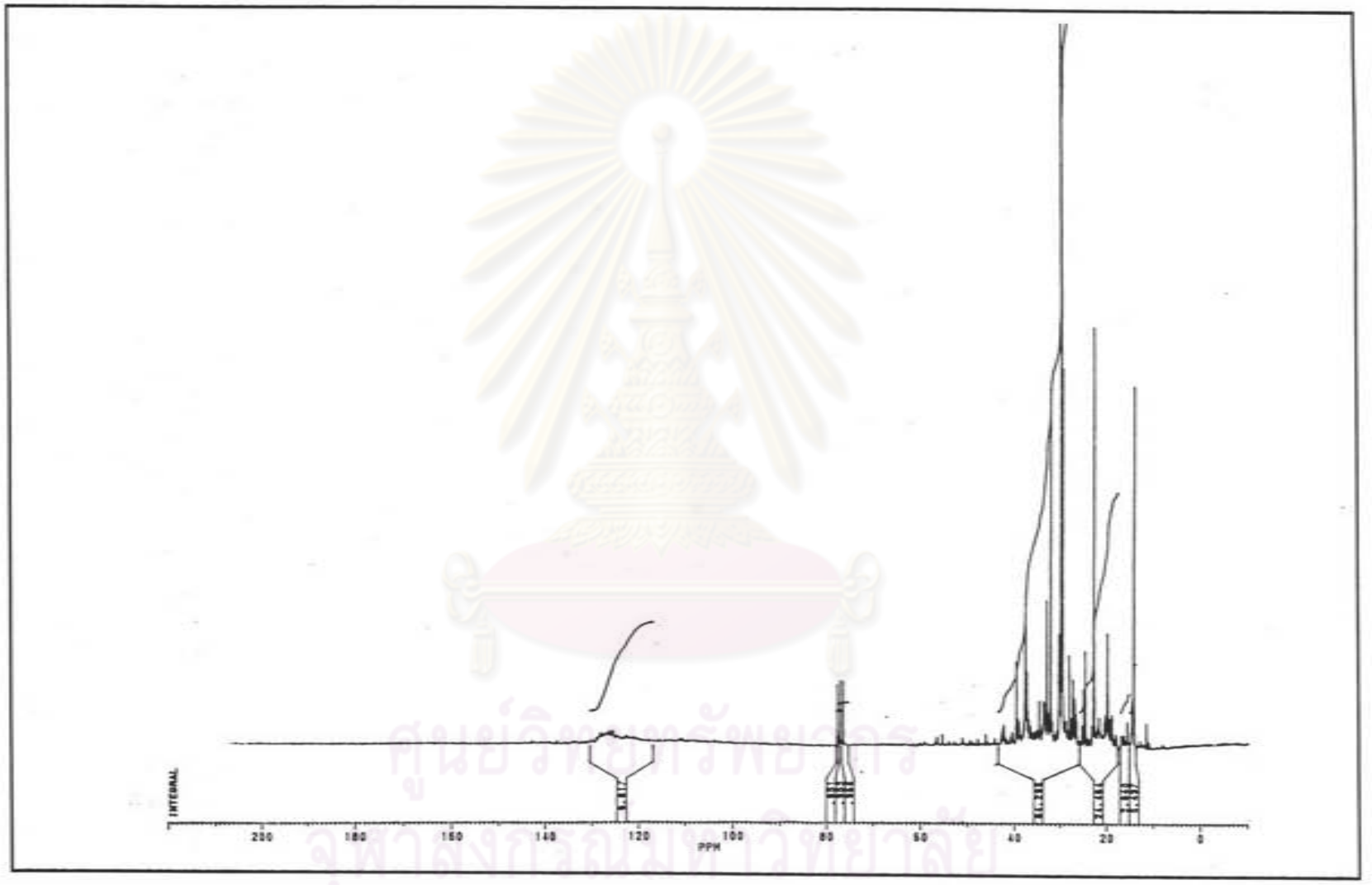

Figure A1 ^{13}C-NMR spectrum of dewaxed oil.

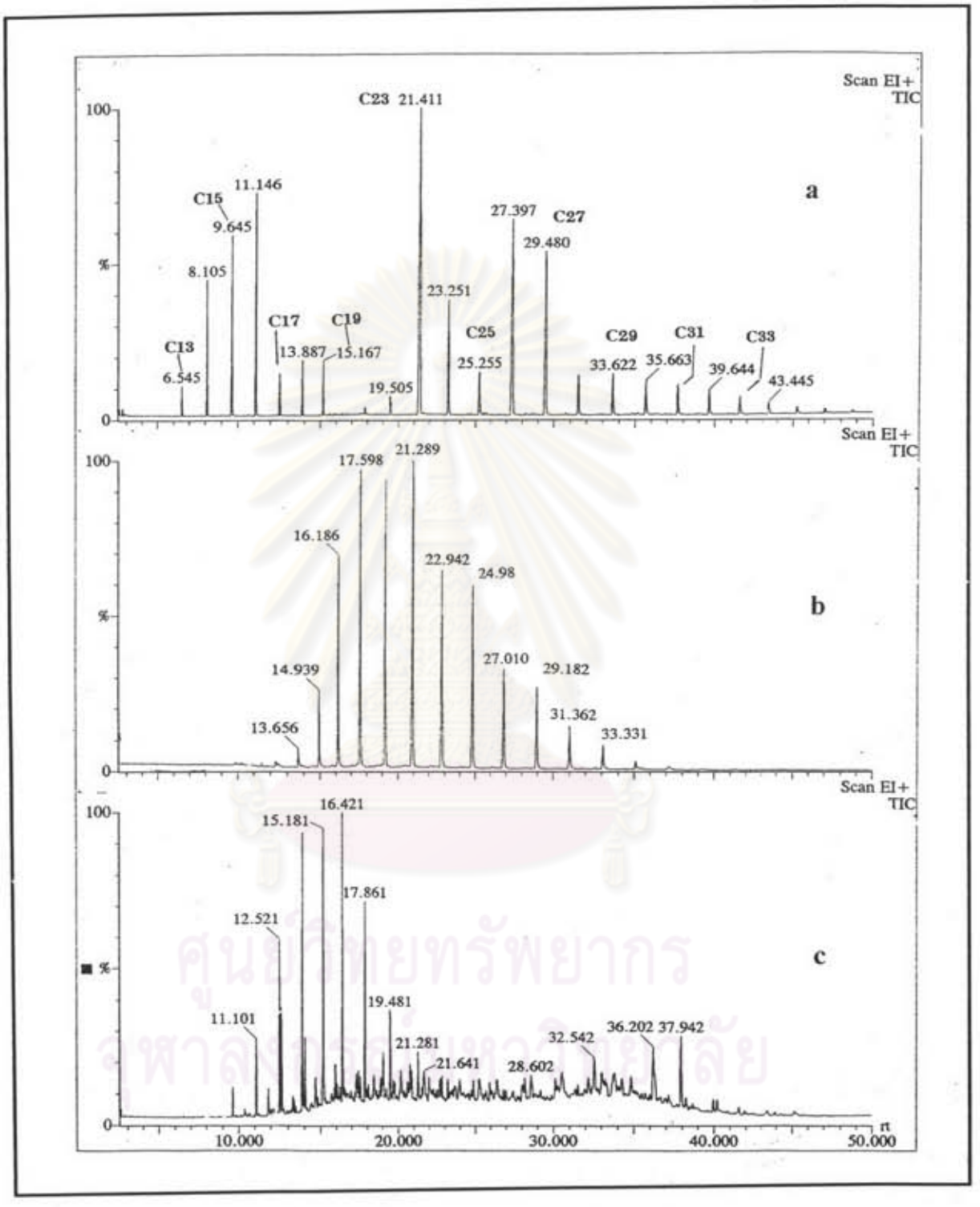

Figure A2 GC-MS chromatograms of **a)** Straight chain alkanes **b)** Fang light distillate **c)** Dewaxed oil.

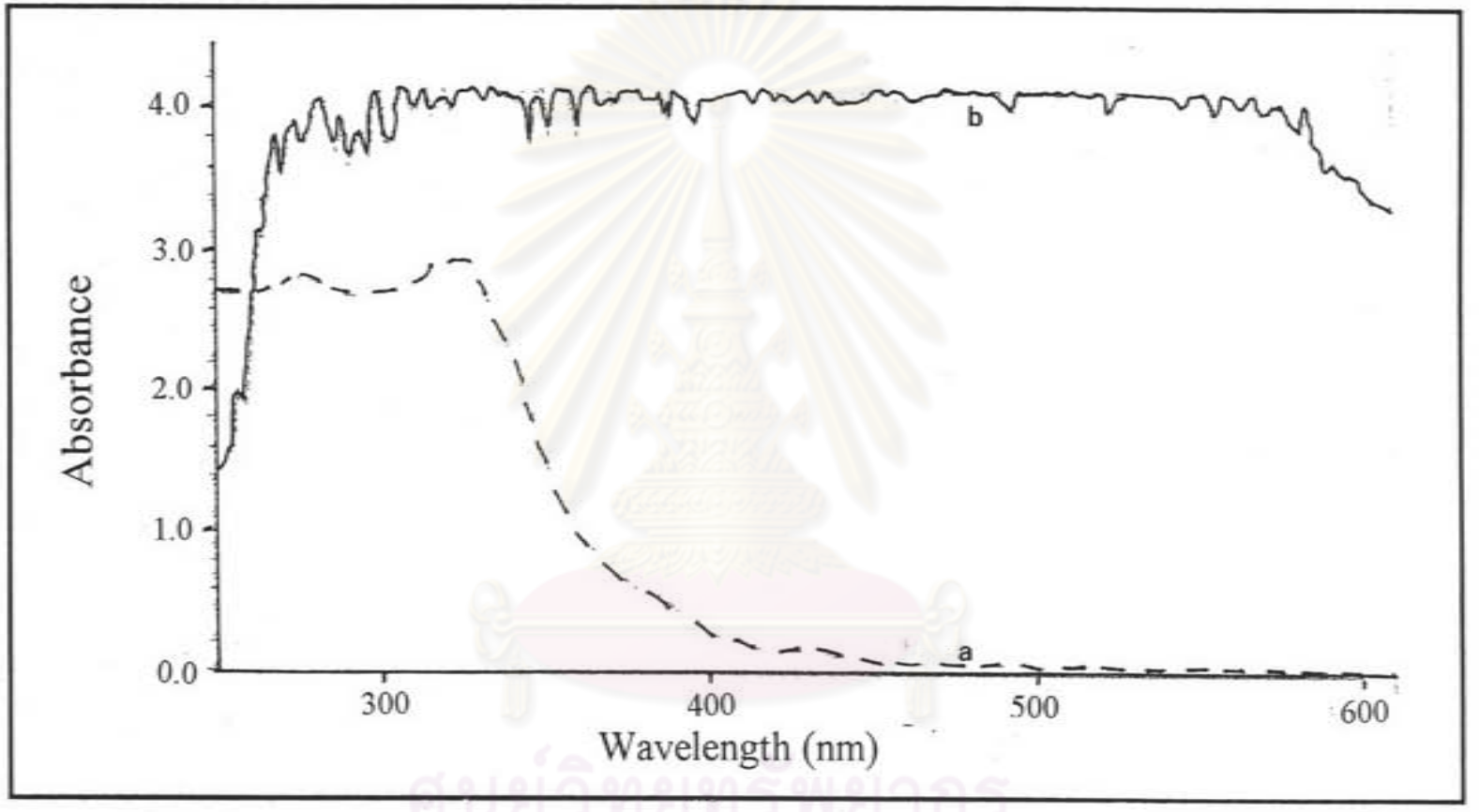

Figure A3 UV spectra of **a)** dewaxed oil in iso-octane **b)** DMSO extract of dewaxed oil.

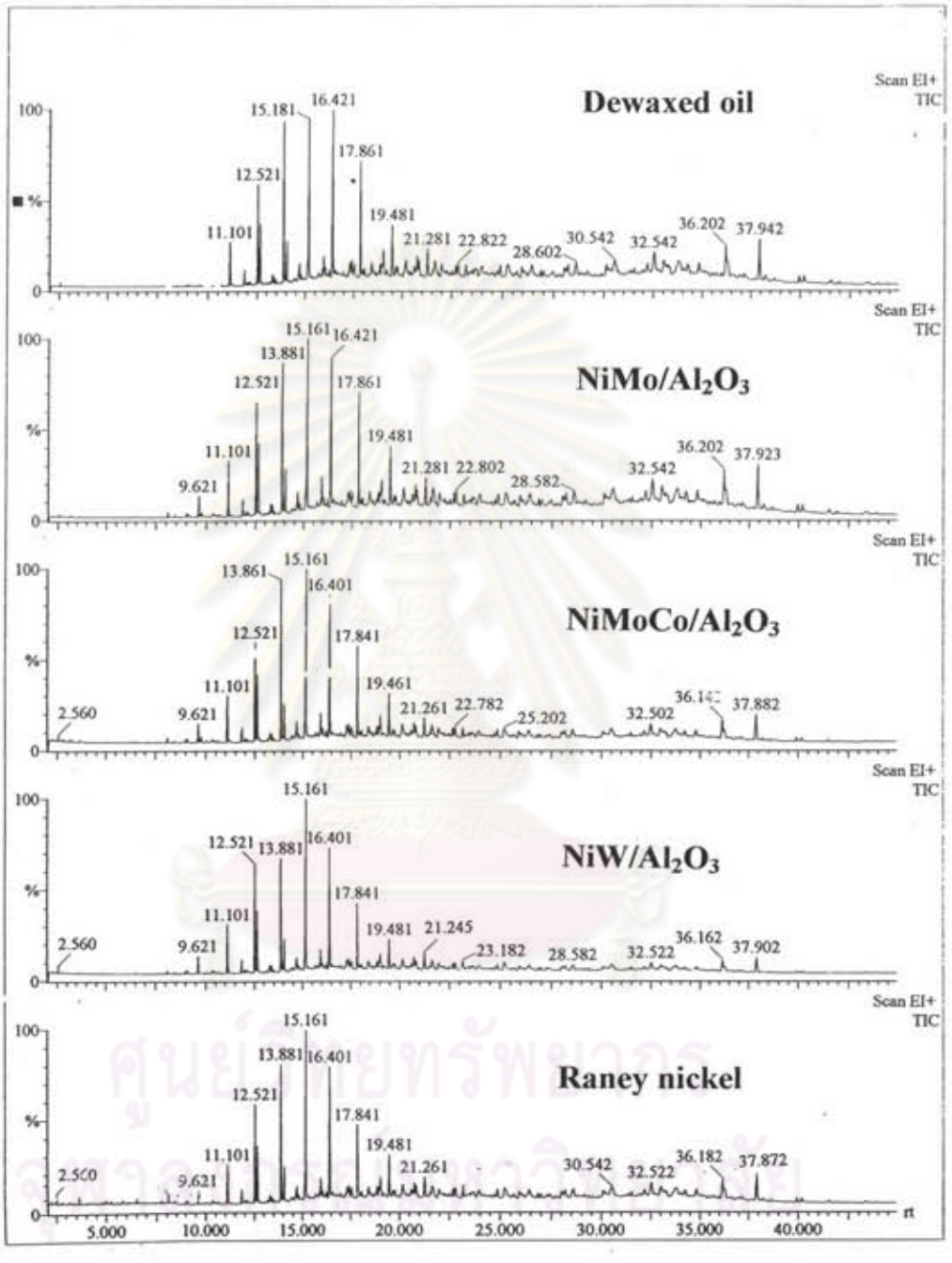

Figure A4 GC-MS chromatograms of hydrodesulfurized oils at various catalyst types.

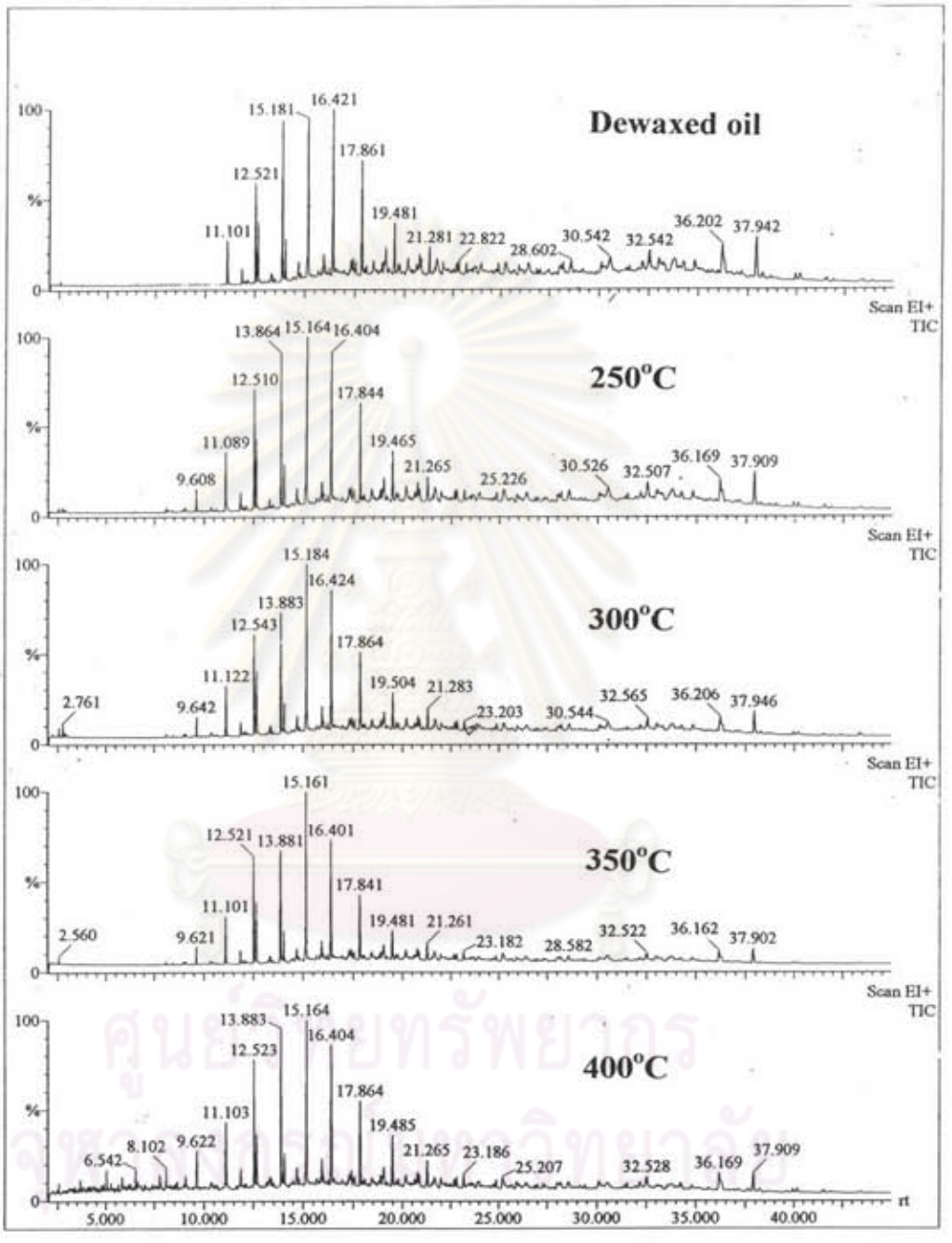

Figure A5 GC-MS chromatograms of hydrodesulfurized oils at various reaction tempertures.

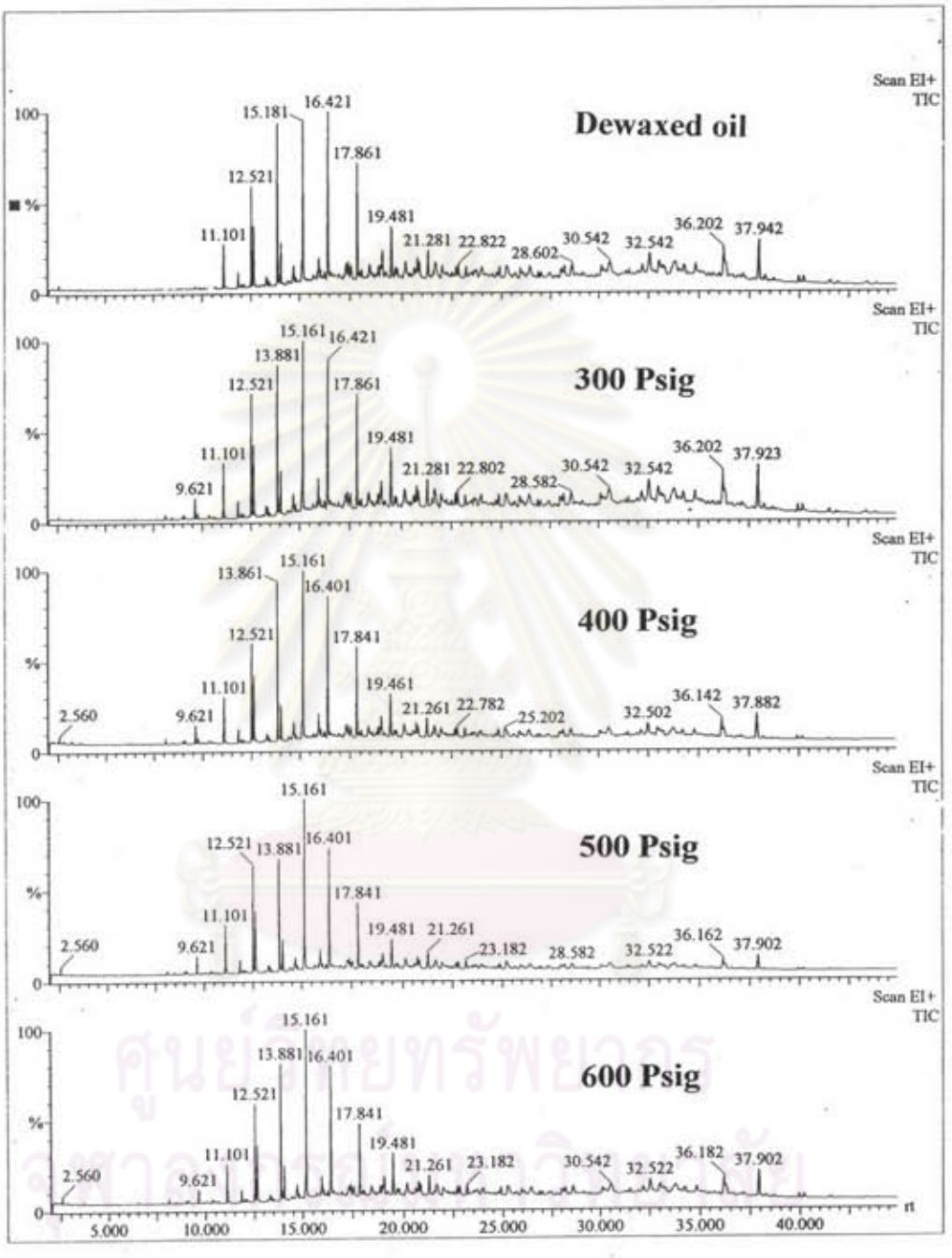

Figure A6 GC-MS chromatograms of hydrodesulfurized oils at various hydrogen pressure.

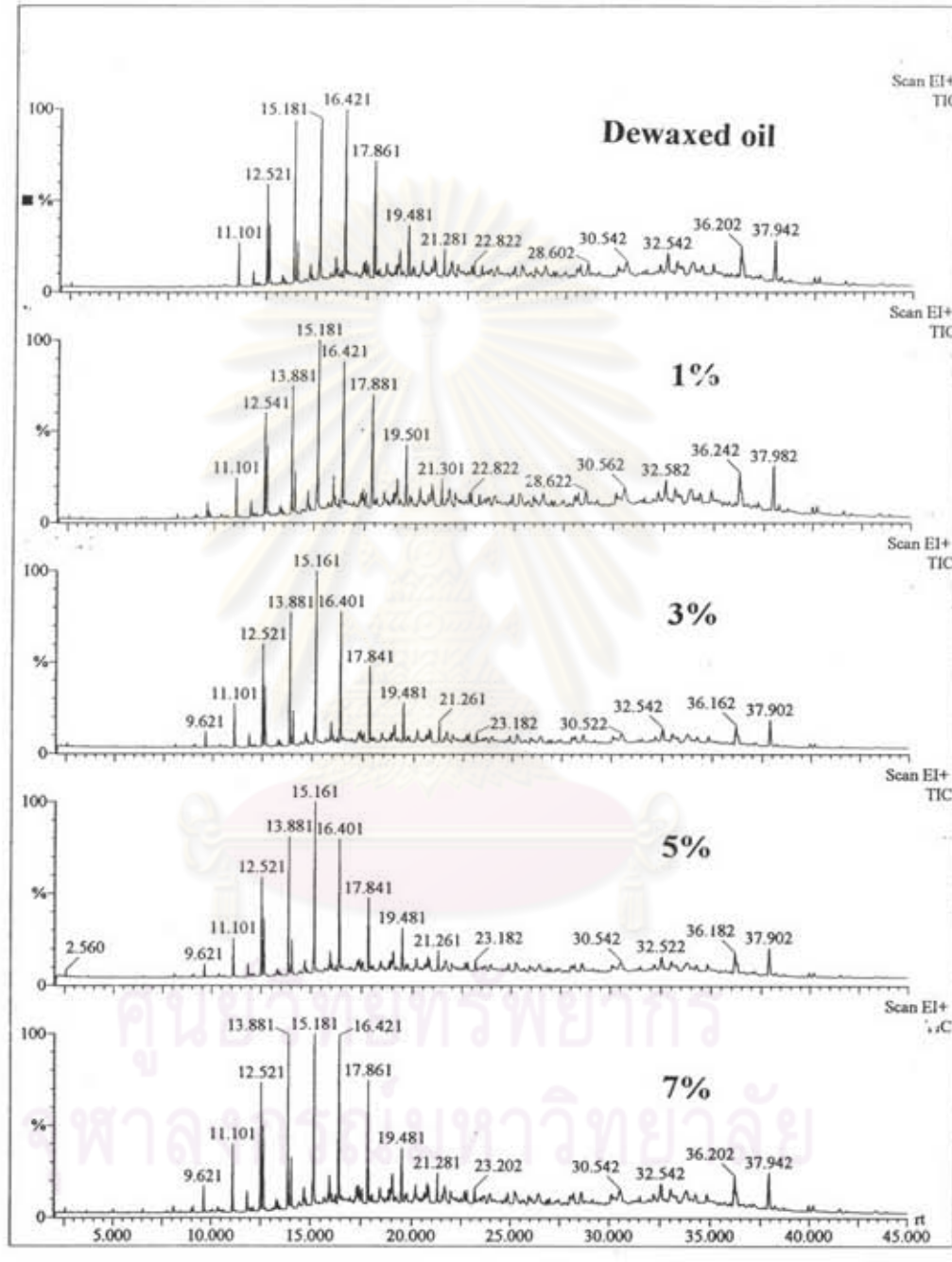

Figure A7 A7 GC-MS chromatograms of hydrodesulfurized oils at various catalyst concentrations (by weight of oil).

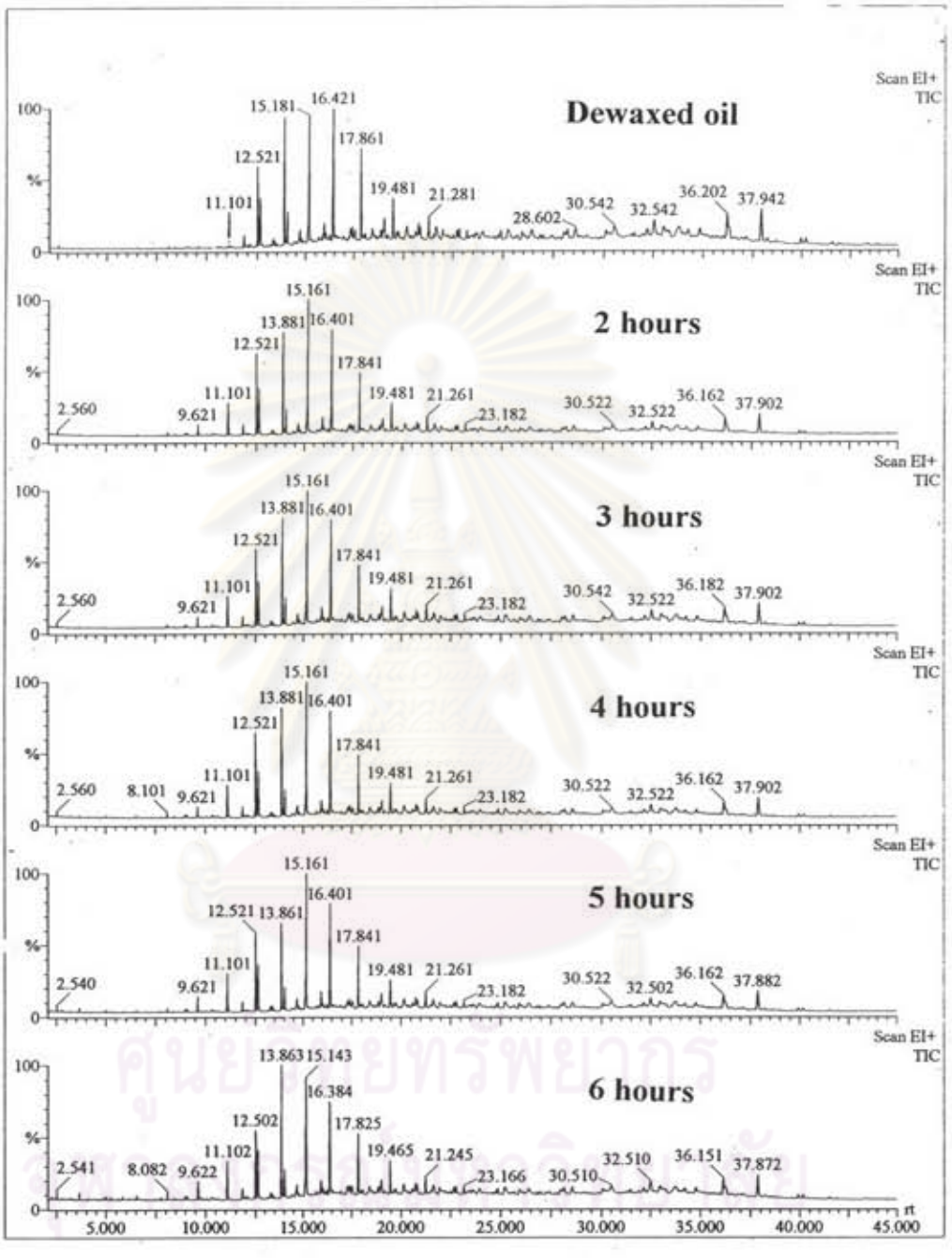

Figure A8 GC-MS chromatograms of hydrodesulfurized oils at various reaction times.

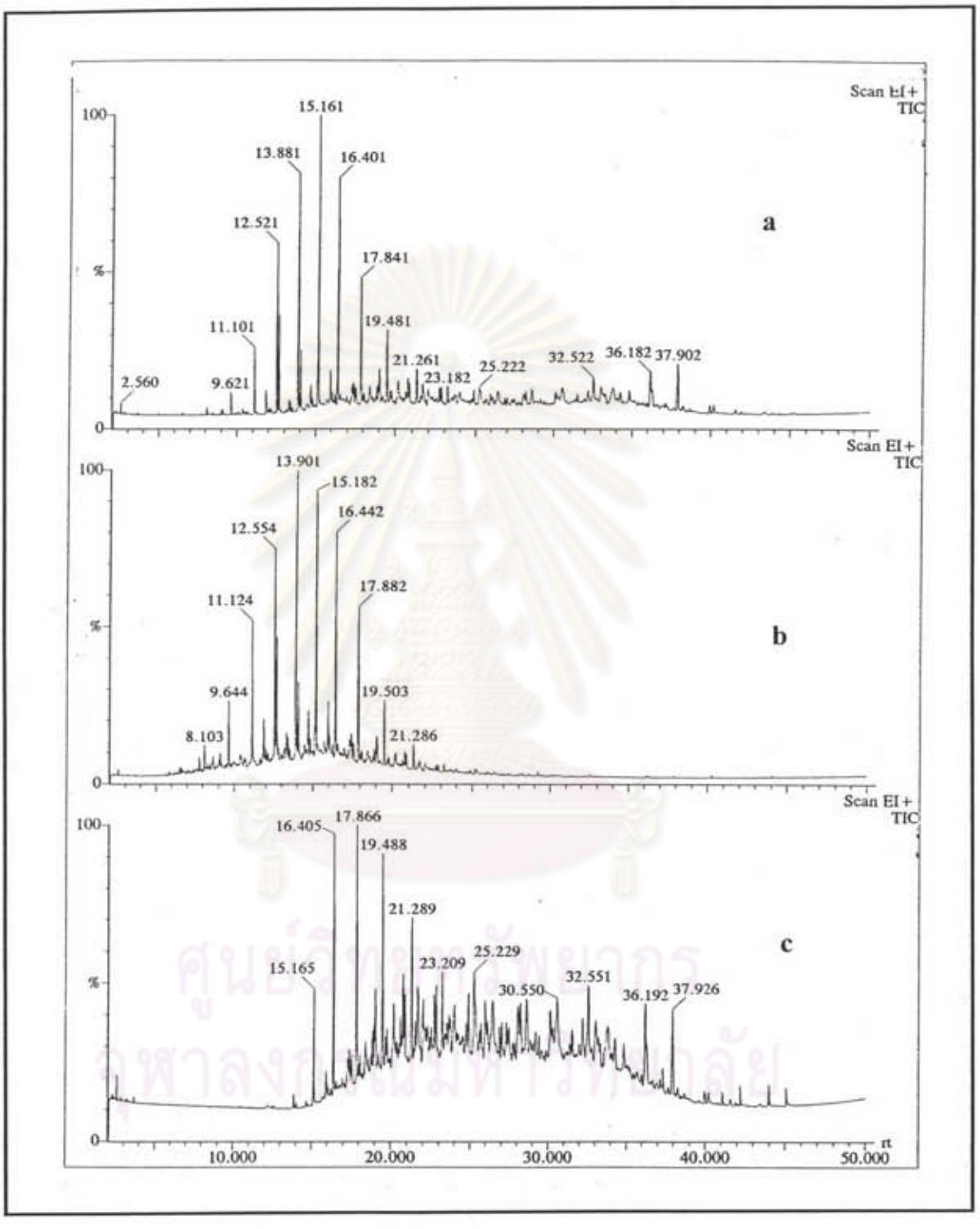

Figure A9 A9 GC-MS chromatograms of the second hydrodesulfurized oils.

a) before distillation **b)** a boiling range below 330°C **c)** a boiling range of 330 to 450°C

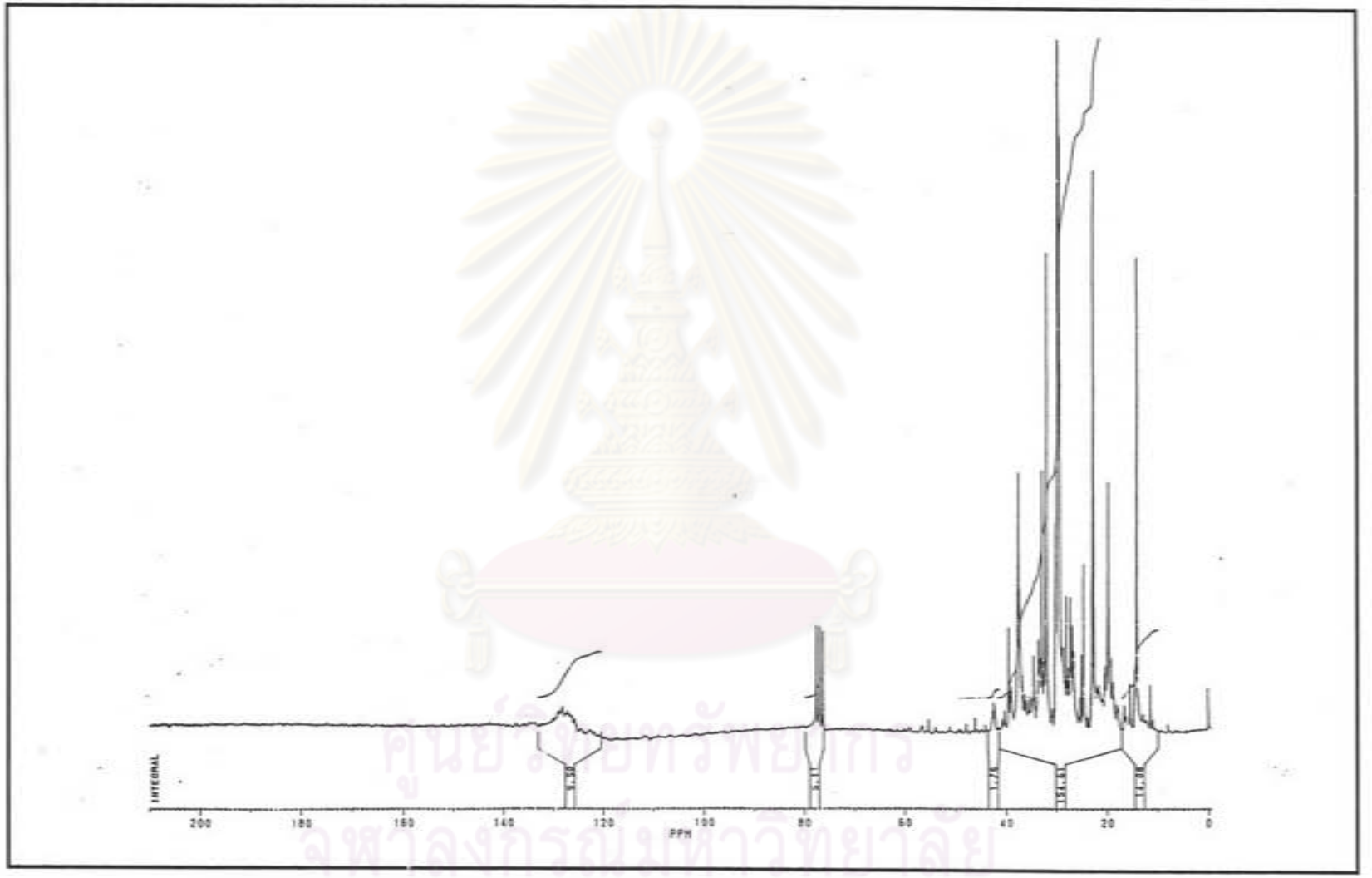

Figure A10 ^{13}C-NMR spectrum of the second hydrodesulfurized oil (330 to 450°C).

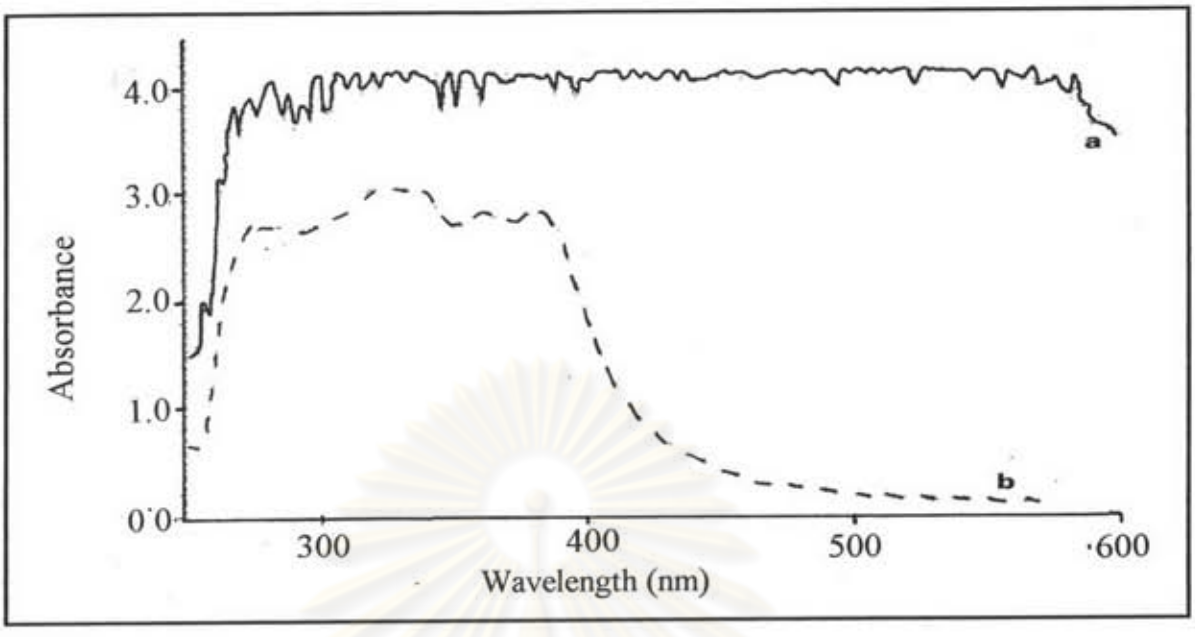

Figure A11 UV spectra of DMSO extracts of **a)** dewaxed oil **b)** the second hydrodesulfurized oil (330 to 450°C).

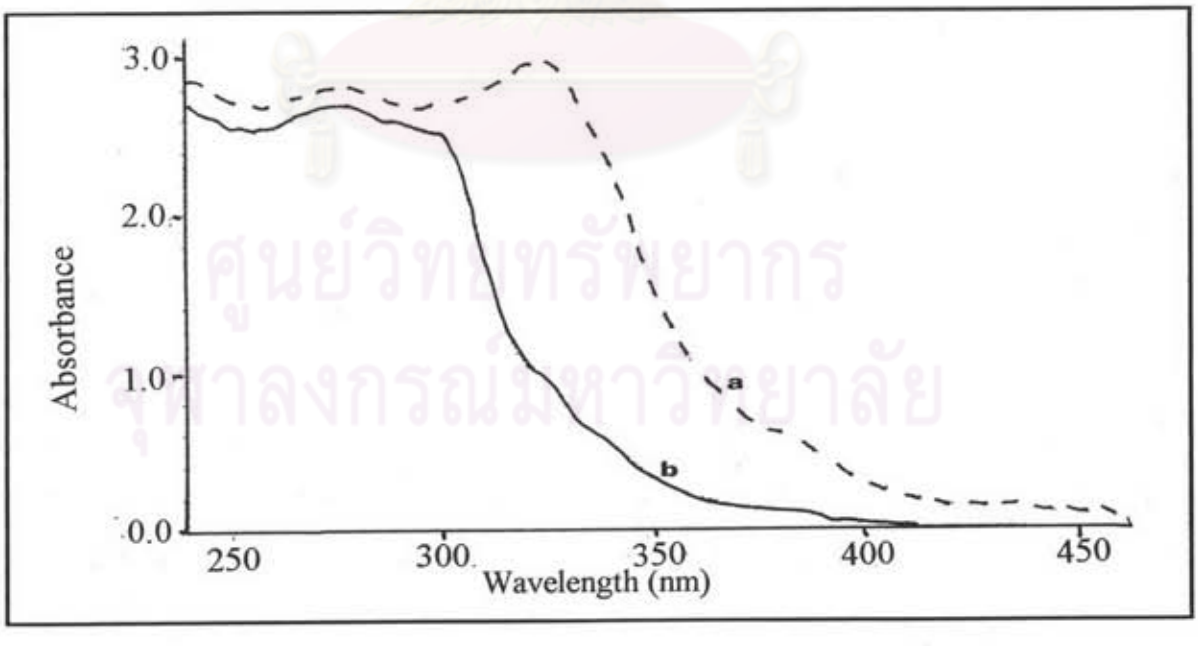

Figure A12 UV spectra of oils in iso-octane **a)** dewaxed oil. **b)** the second hydrodesulfurized oil (330 to 450°C).

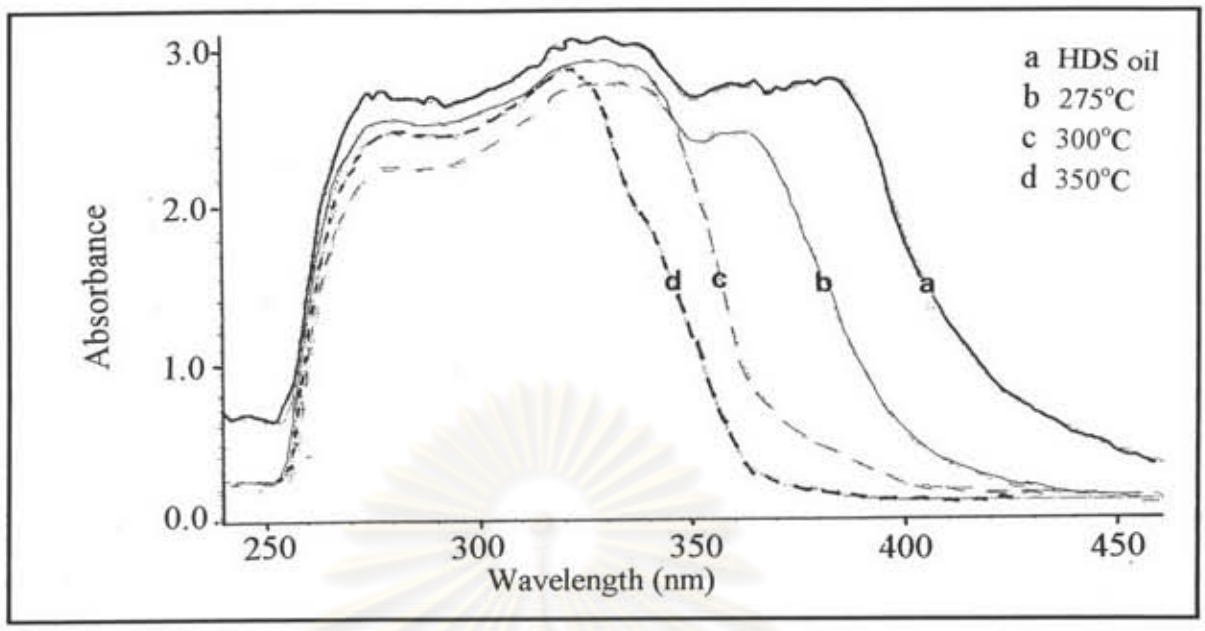

Figure A13 UV spectra of DMSO extracts of hydrogenated oils (330 to 450°C) at Various reaction temperatures.

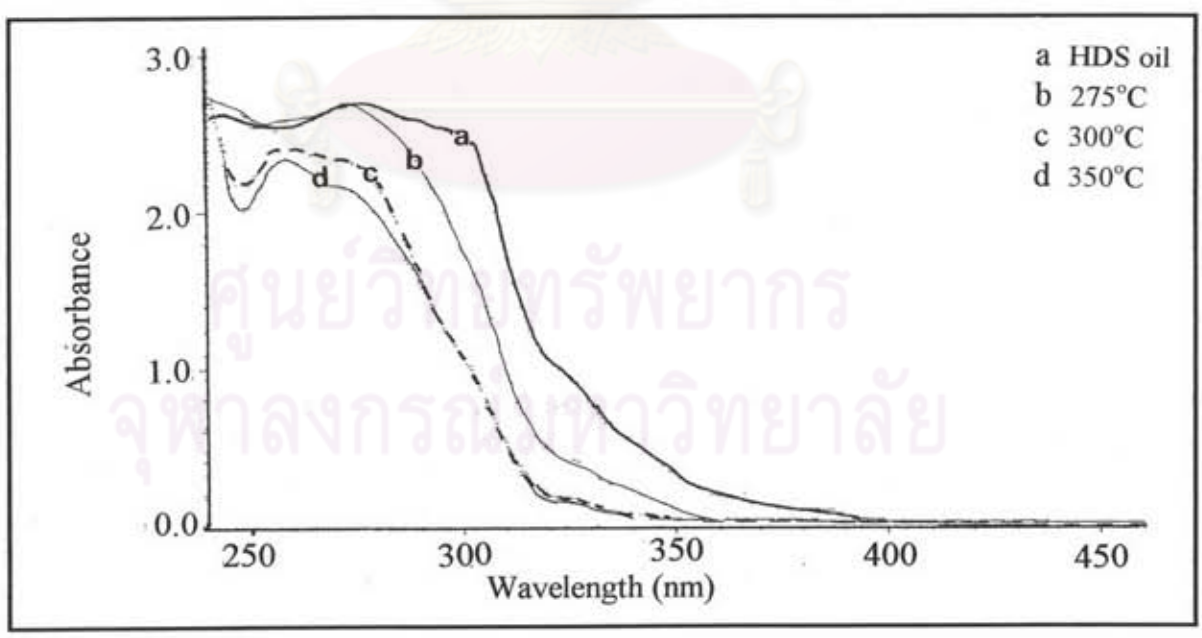

Figure A14 UV spectra of hydrogenated oils (330 to 450°C) in iso-octane at various reaction temperatures.

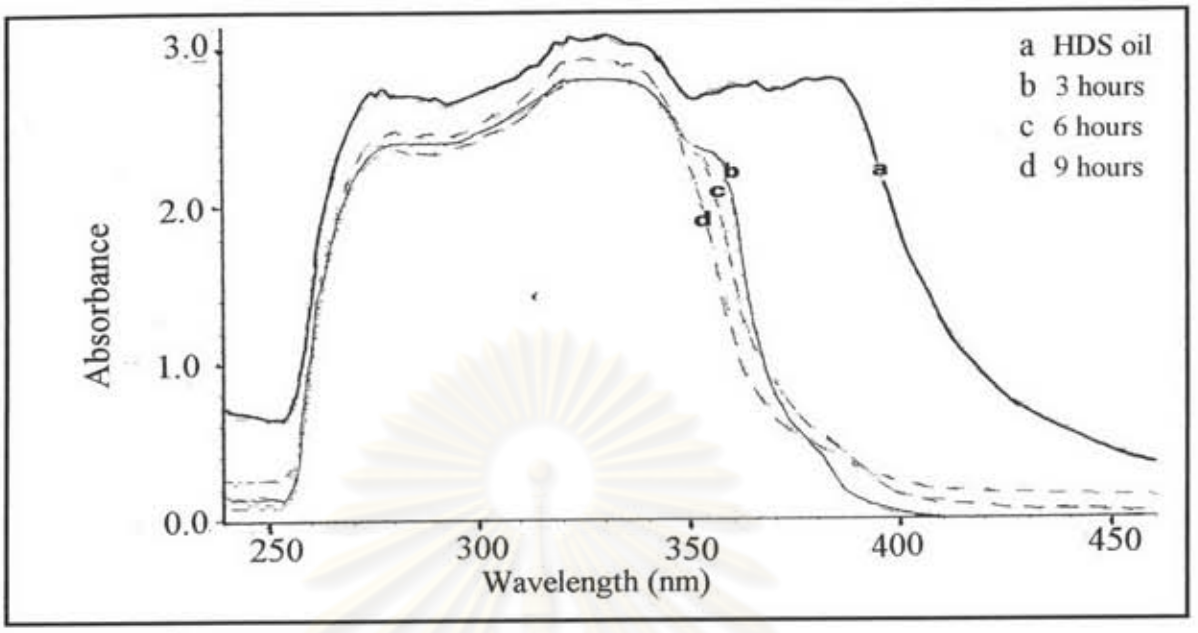

Figure A15 UV spectra of DMSO extracts of hydrogenated oils (330 to 450°C) at various reaction times.

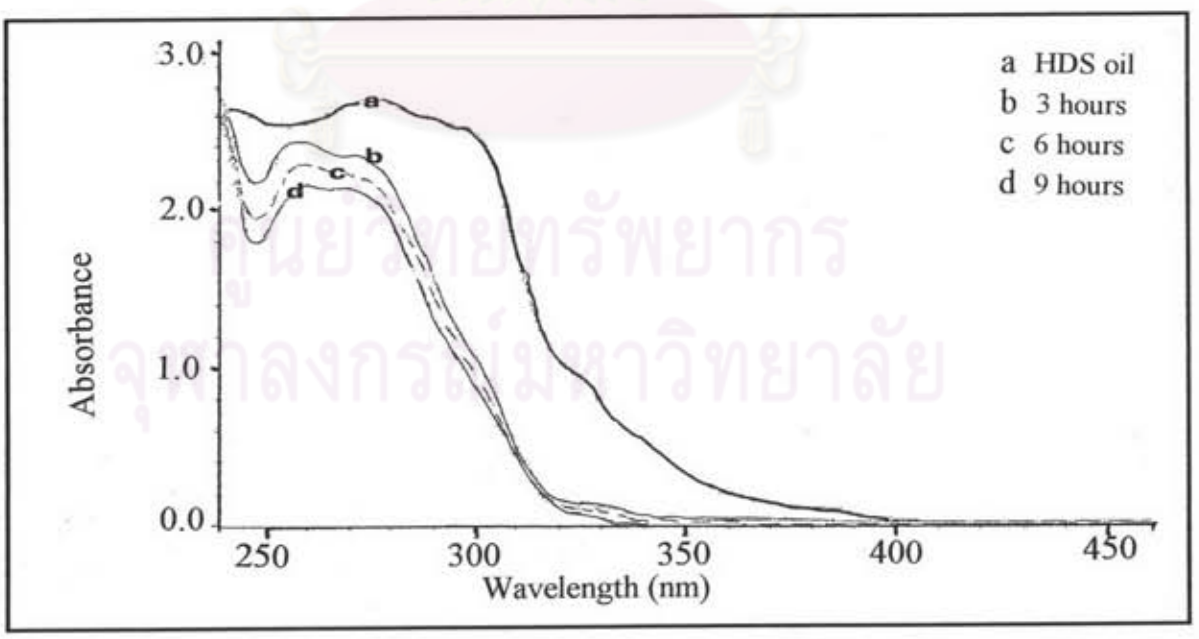

Figure A16 UV spectra of hydrogenated oils (330 to 450°C) in iso-octane at various reaction times.

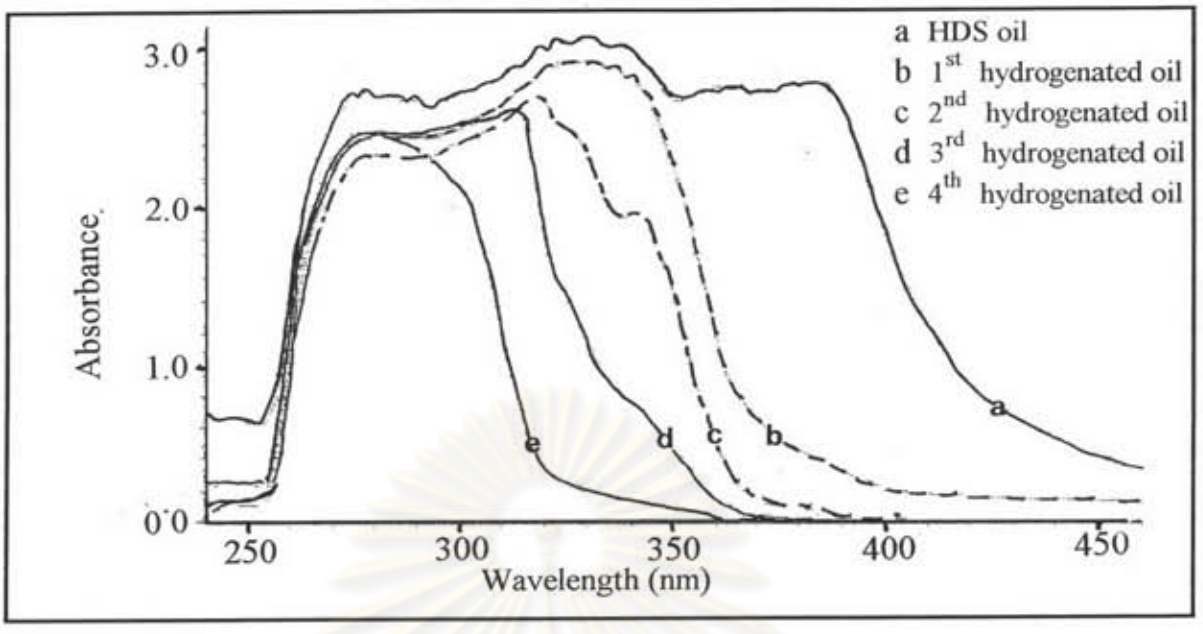

Figure A17 UV spectra of DMSO extracts of hydrogenated oils (330 to 450°C) at multiple hydrogenation.

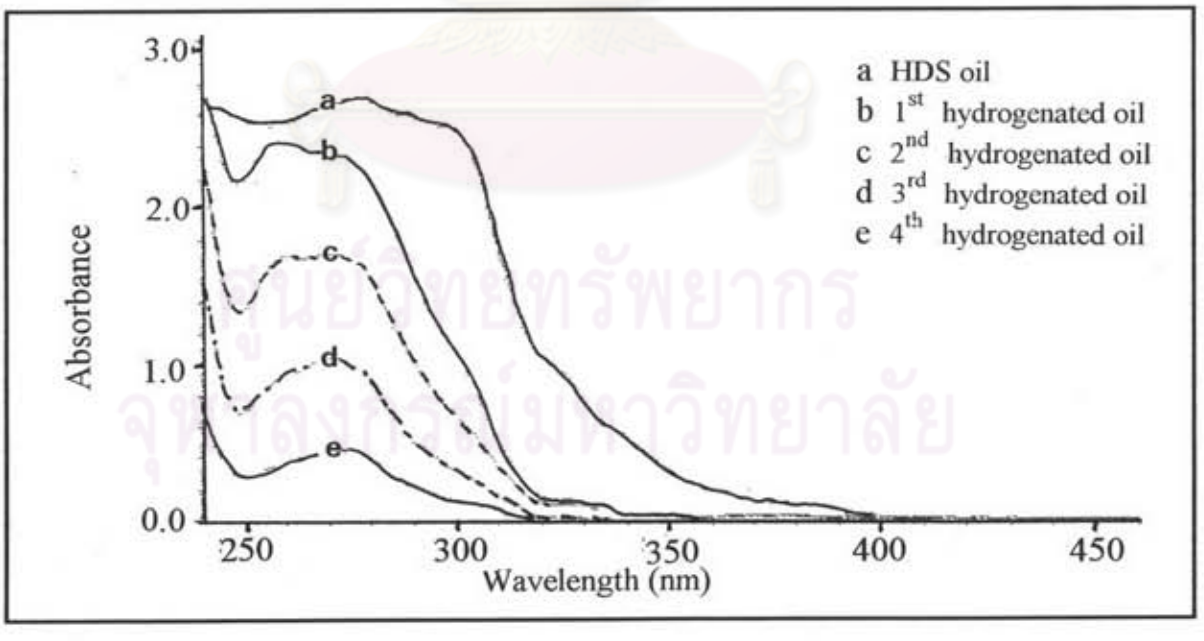

Figure A18 UV spectra of hydrogenated oils (330 to 450°C) in iso-octane at multiple hydrogenation.

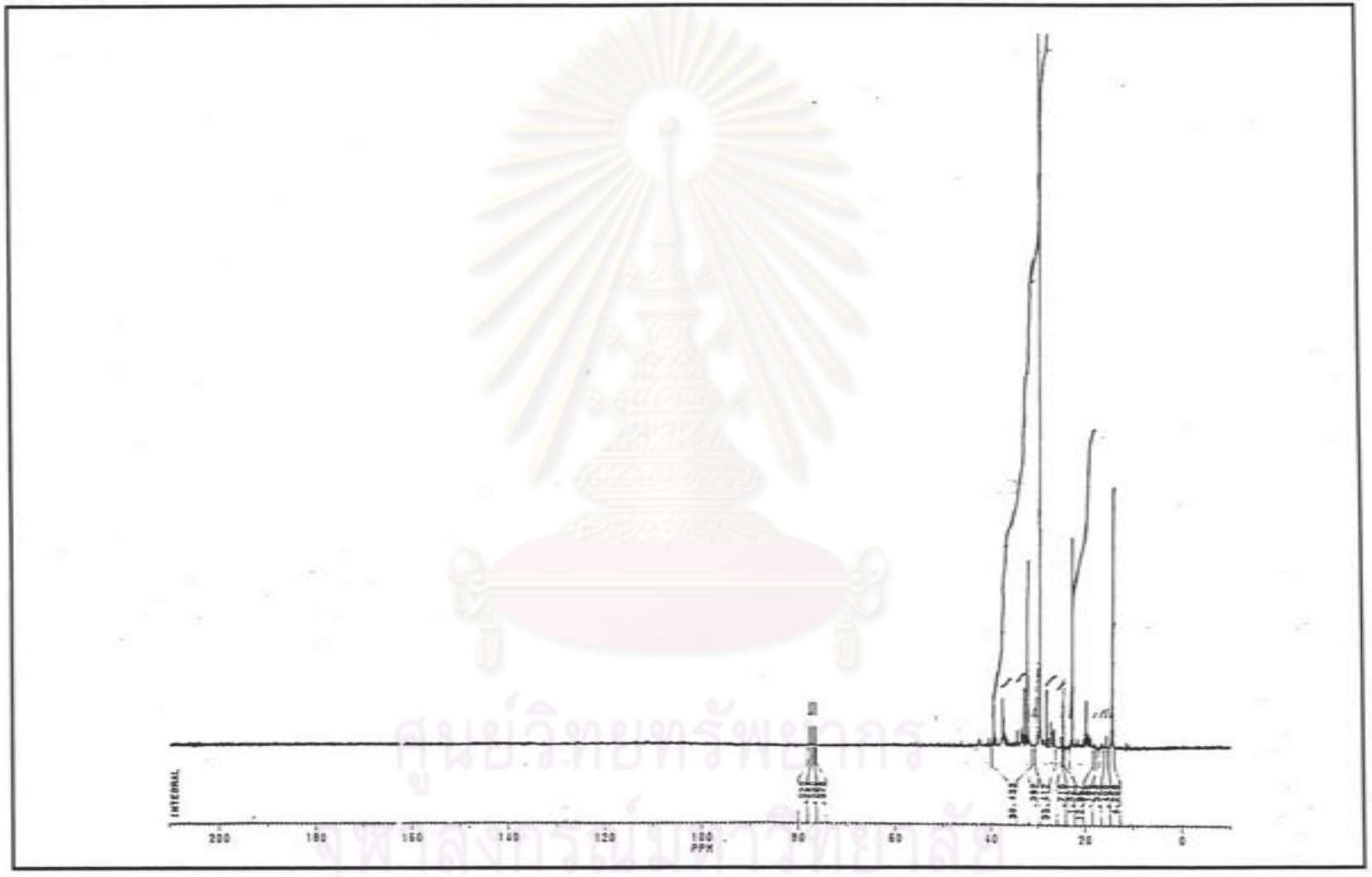

Figure A19 ^{13}C-NMR spectrum of technical white oil.

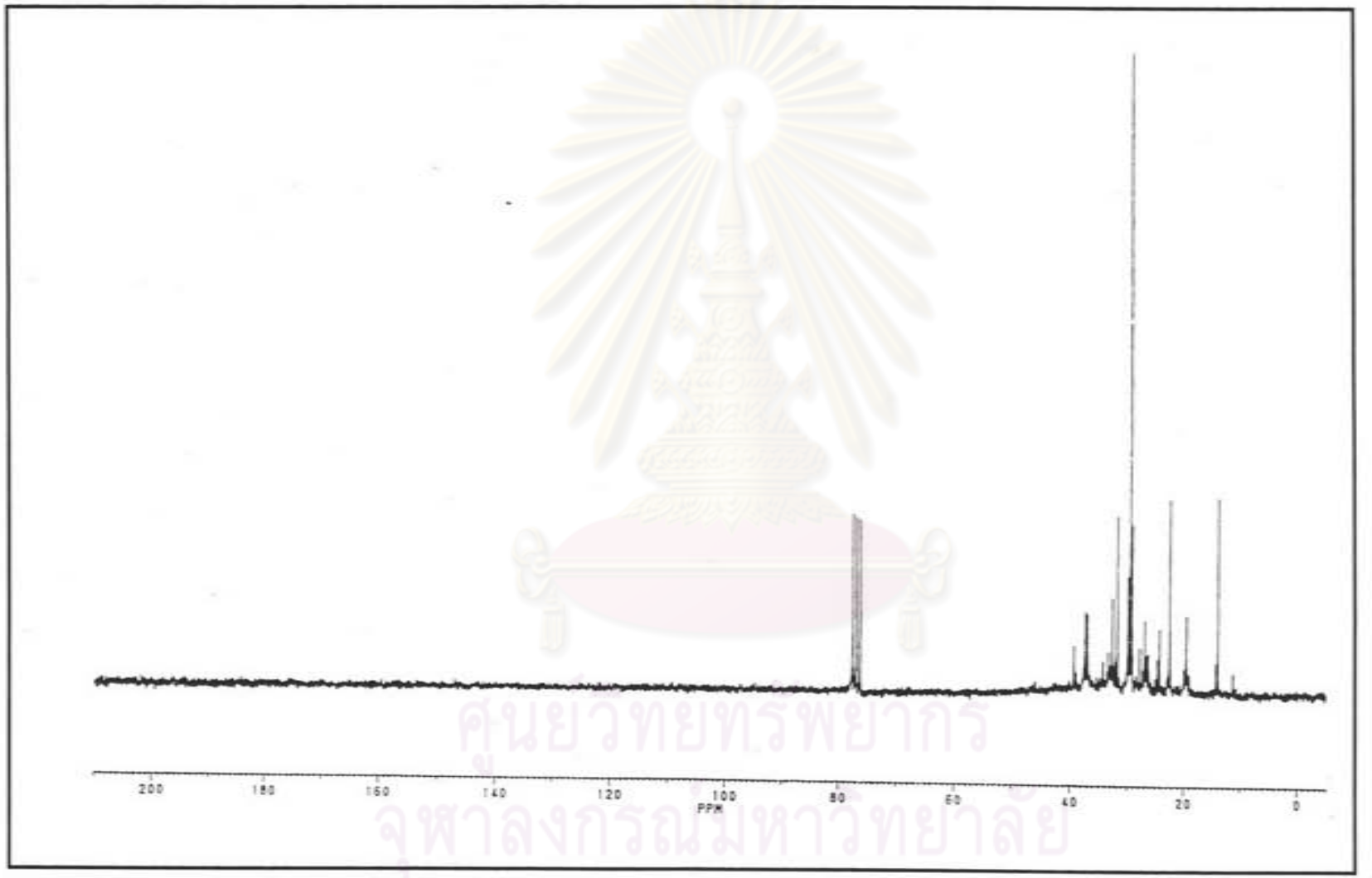

Figure A20 ^{13}C-NMR spectrum of Shell Risella white oil 15.

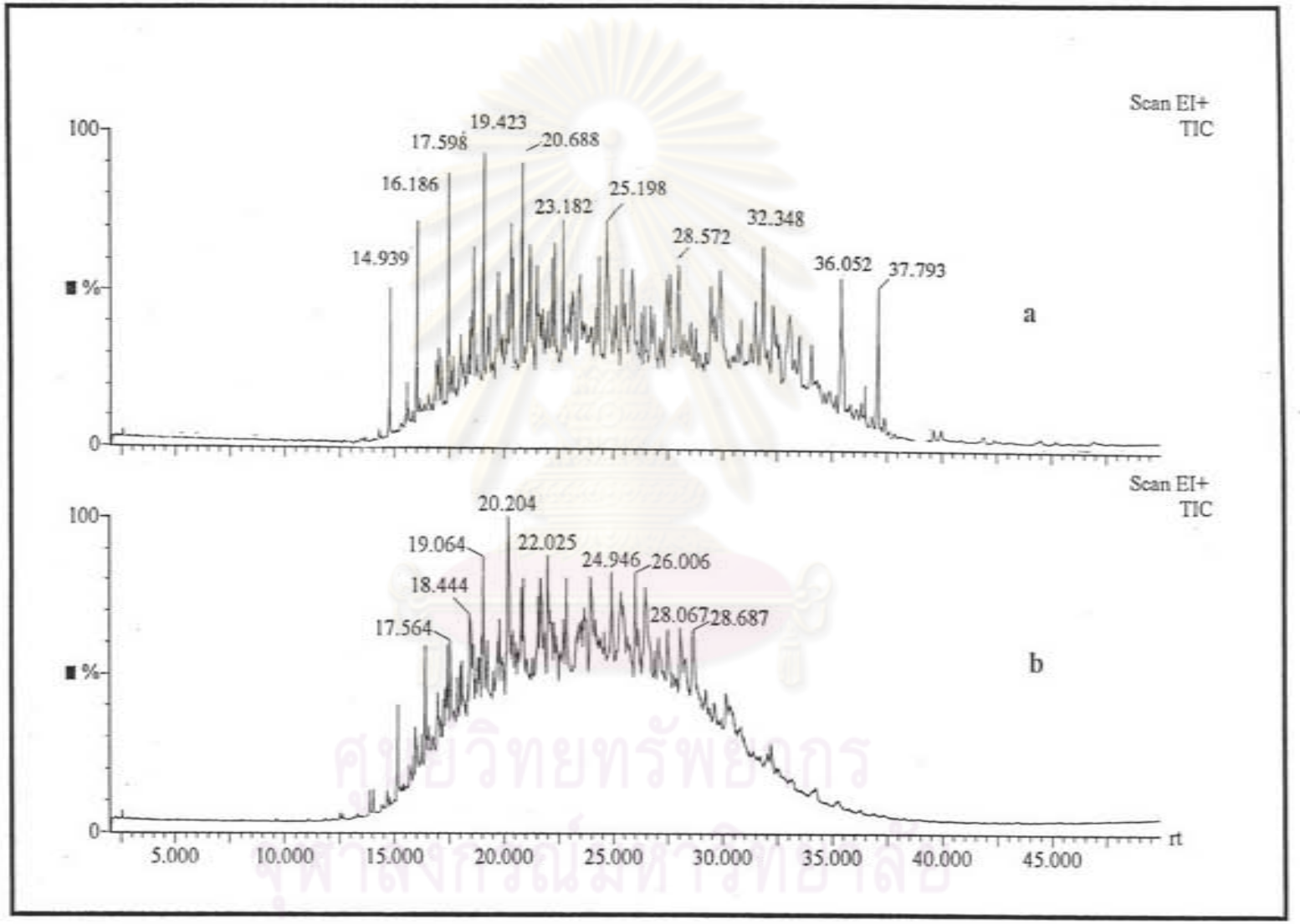

Figure A21 GC-MS chromatograms of **a)** technical white oil **b)** Shell Risella white oil 15.

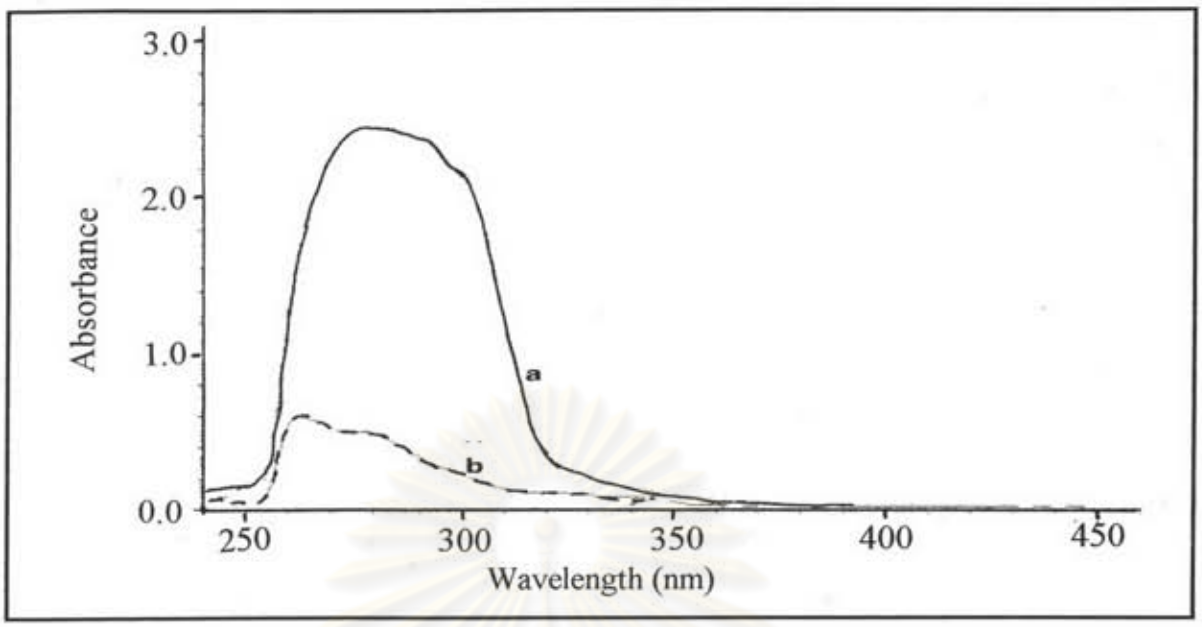

Figure A22 UV spectra of DMSO extracts of **a)** technical white oil **b)** Shell Risella white oil 15.

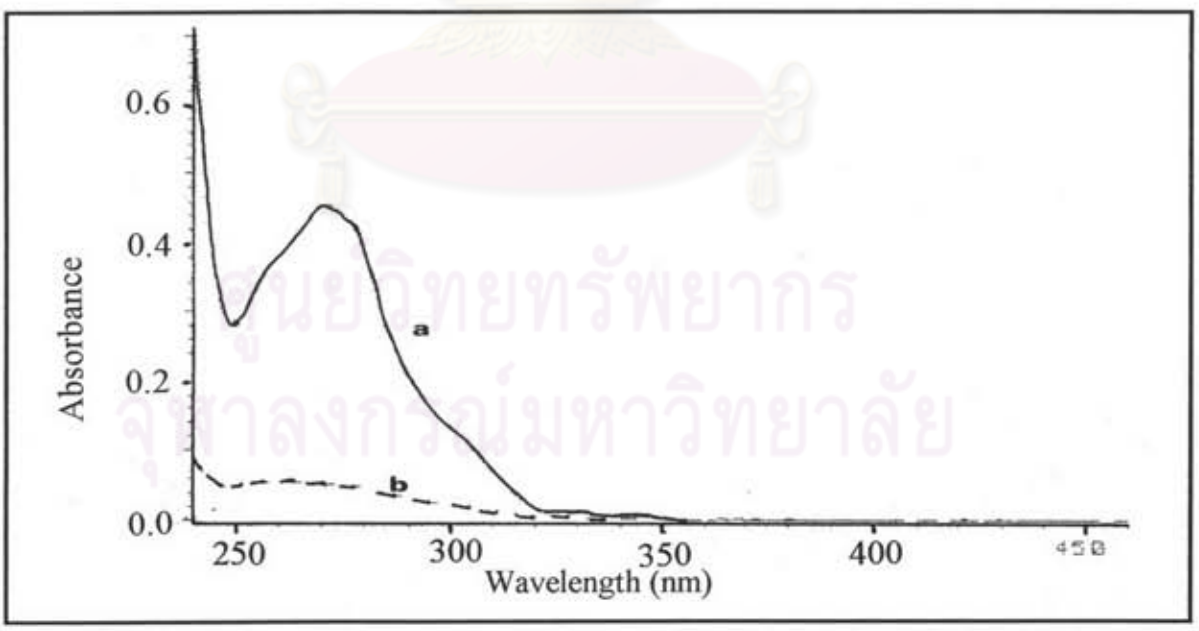

Figure A23 UV spectra of oils **a)** technical white oil in iso-octane b) Shell Risella white oil 15 in iso-octane.

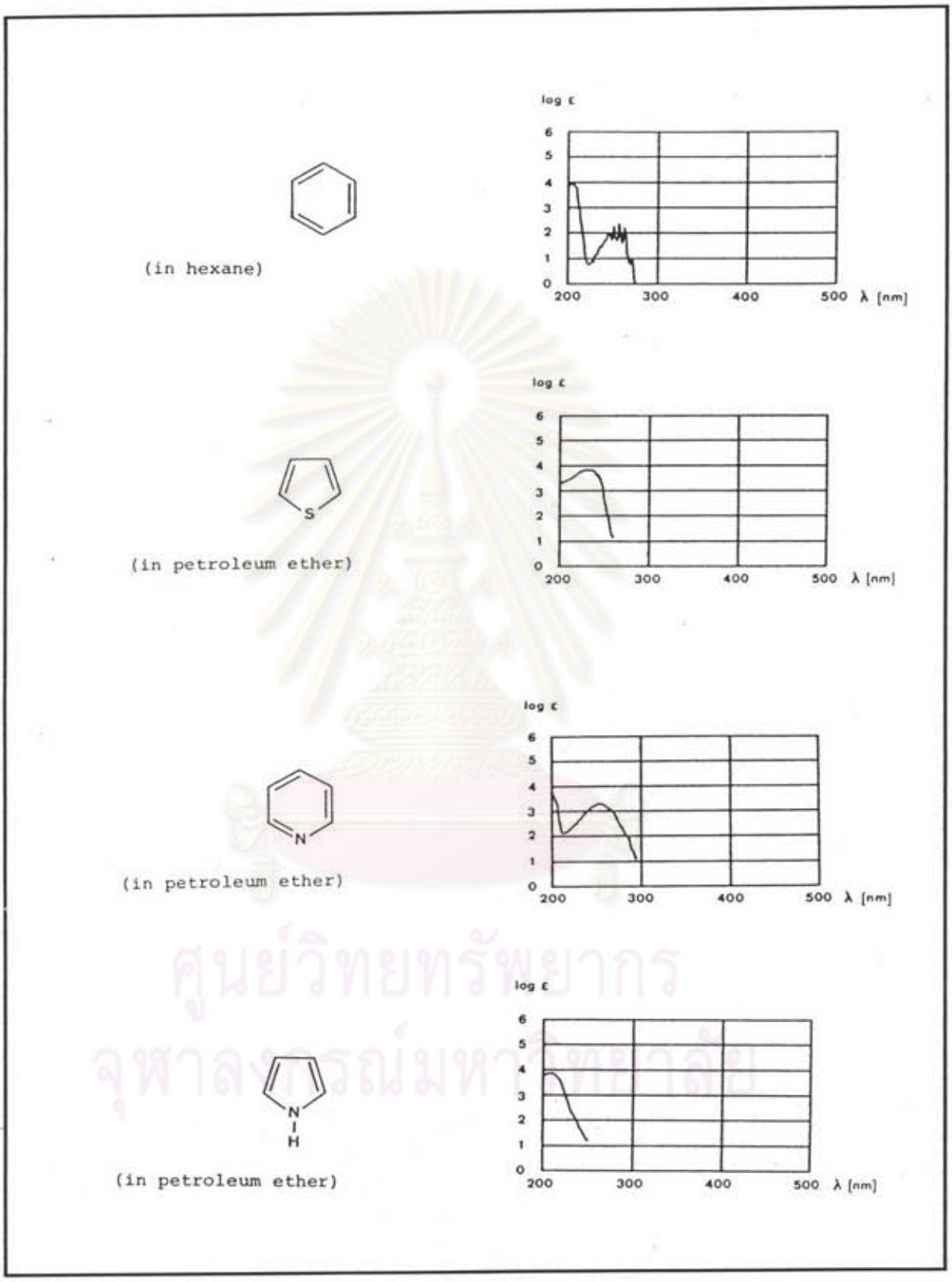

Figure A24 UV spectra of monoaromatic compounds.

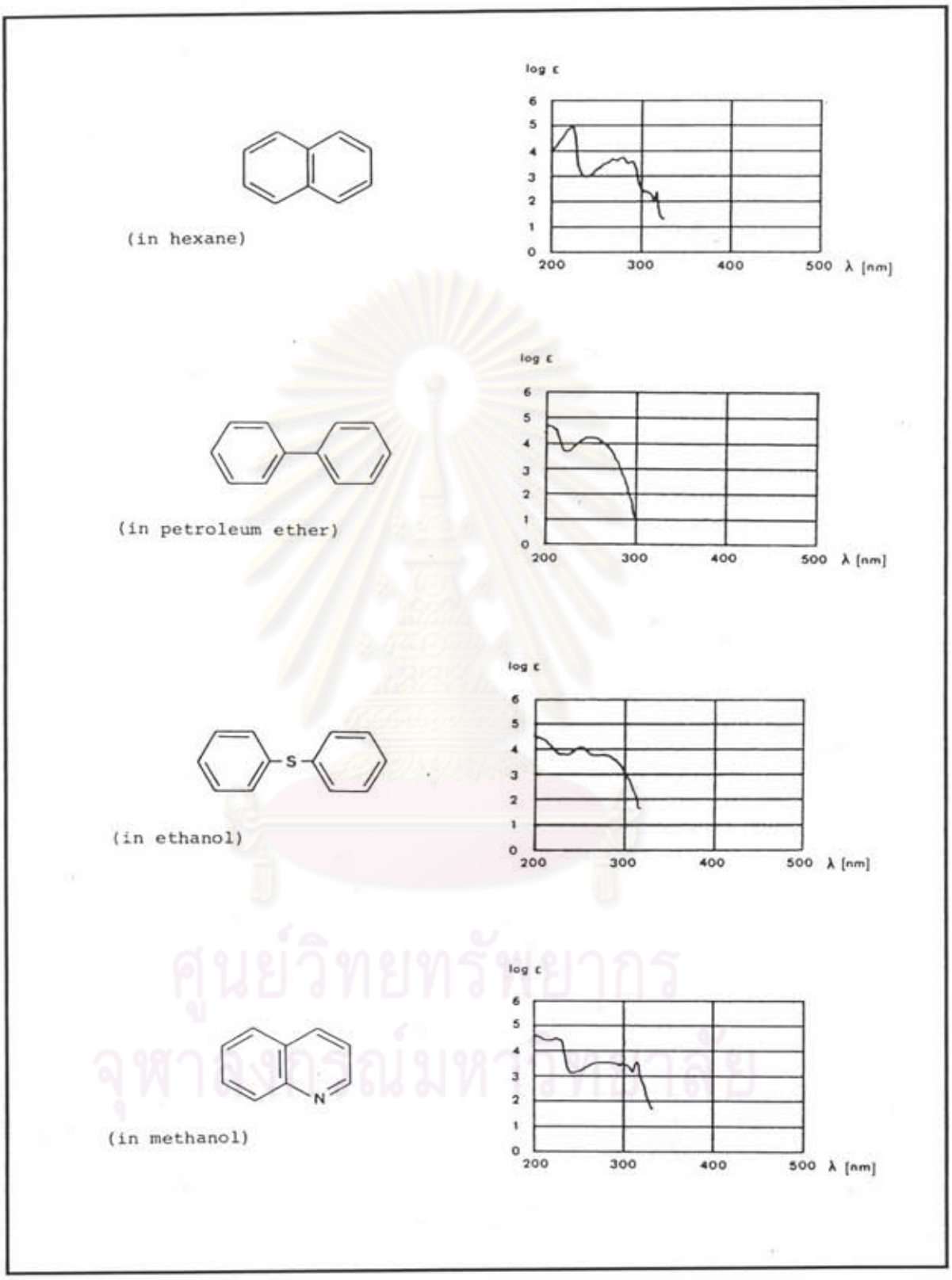

Figure A25 UV spectra of diaromatic compounds.

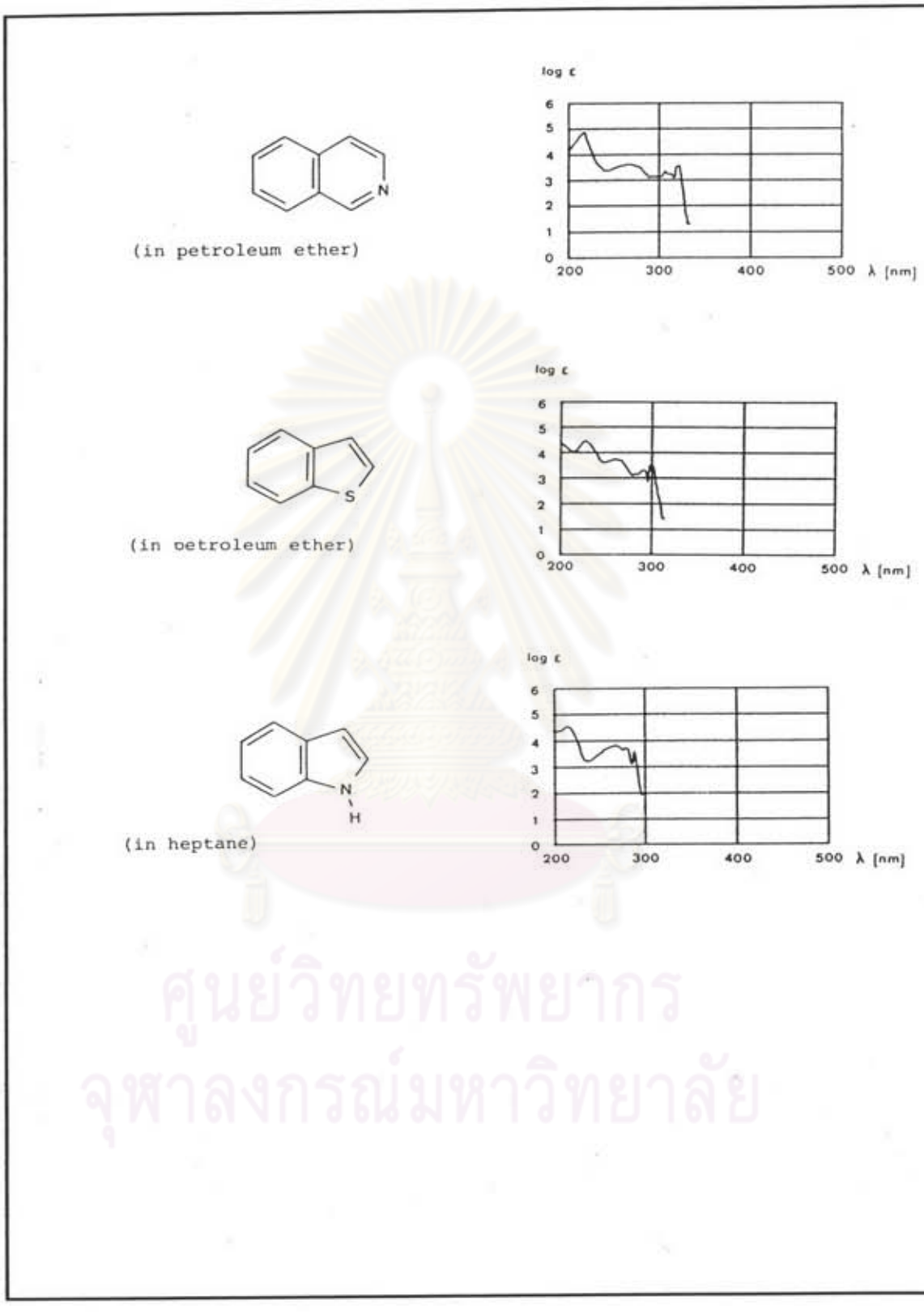

Figure A25 Continued.

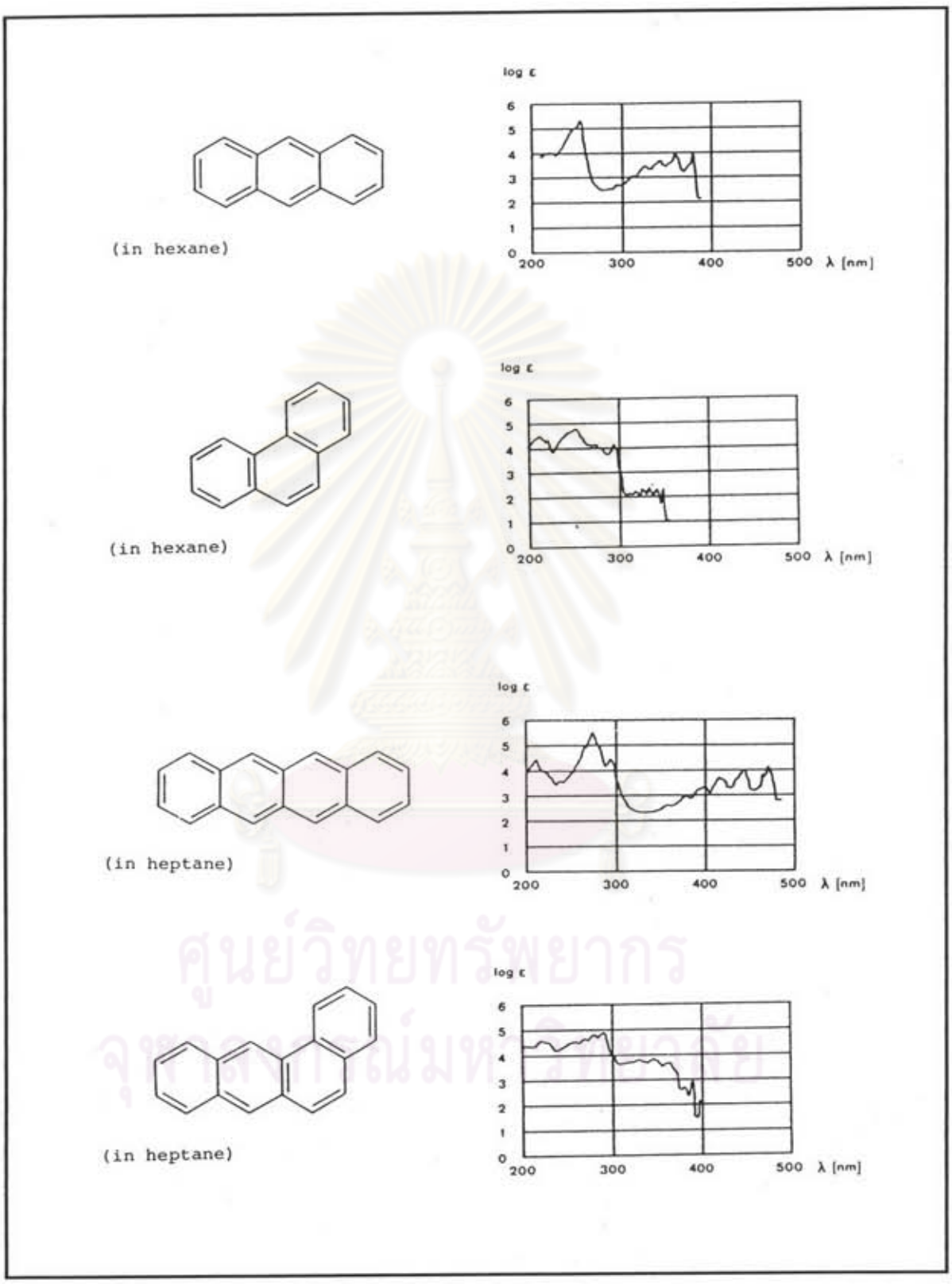

Figure A26 UV spectra of polyaromatic compounds.

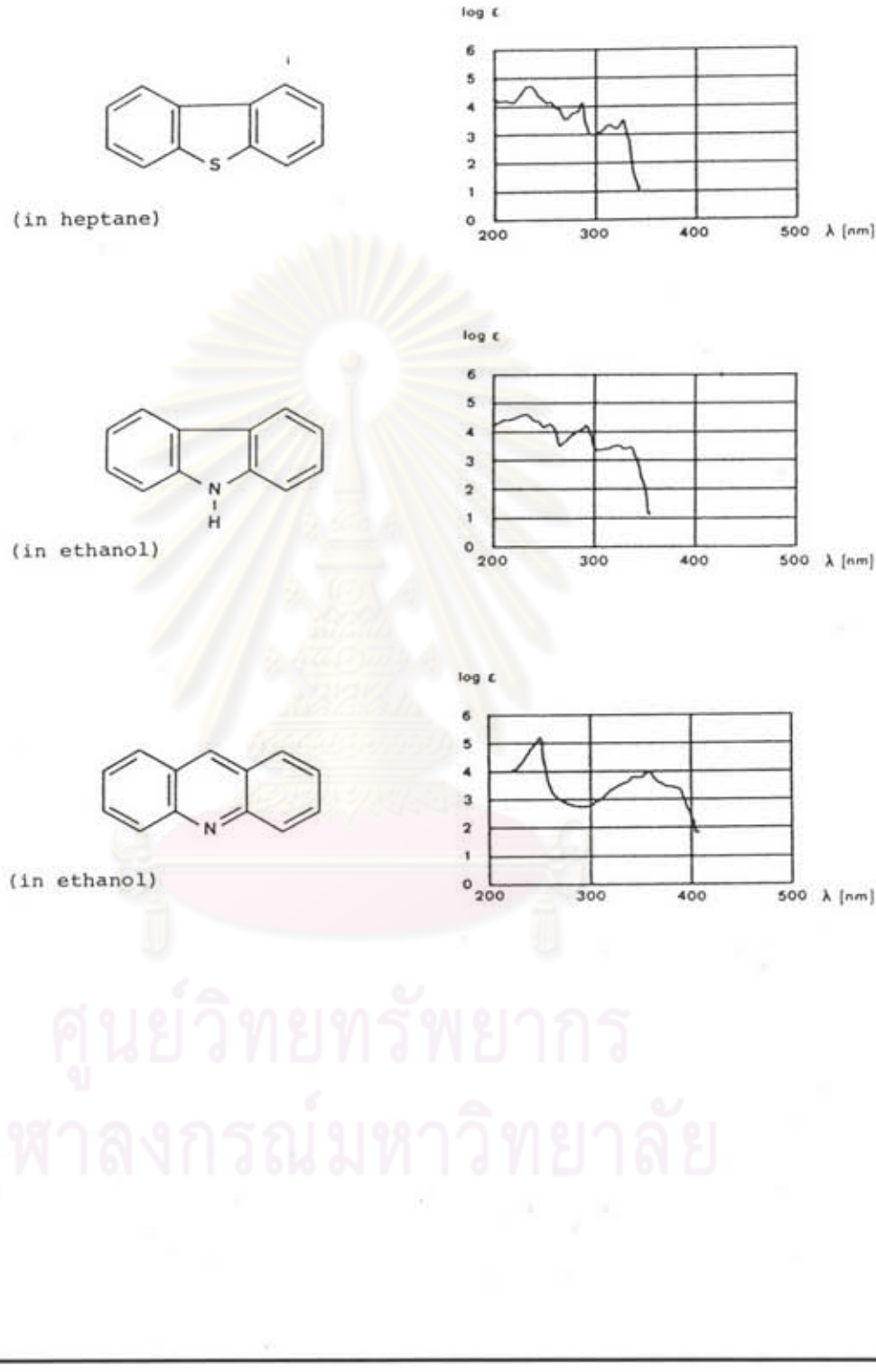

Figure A26 Continued.

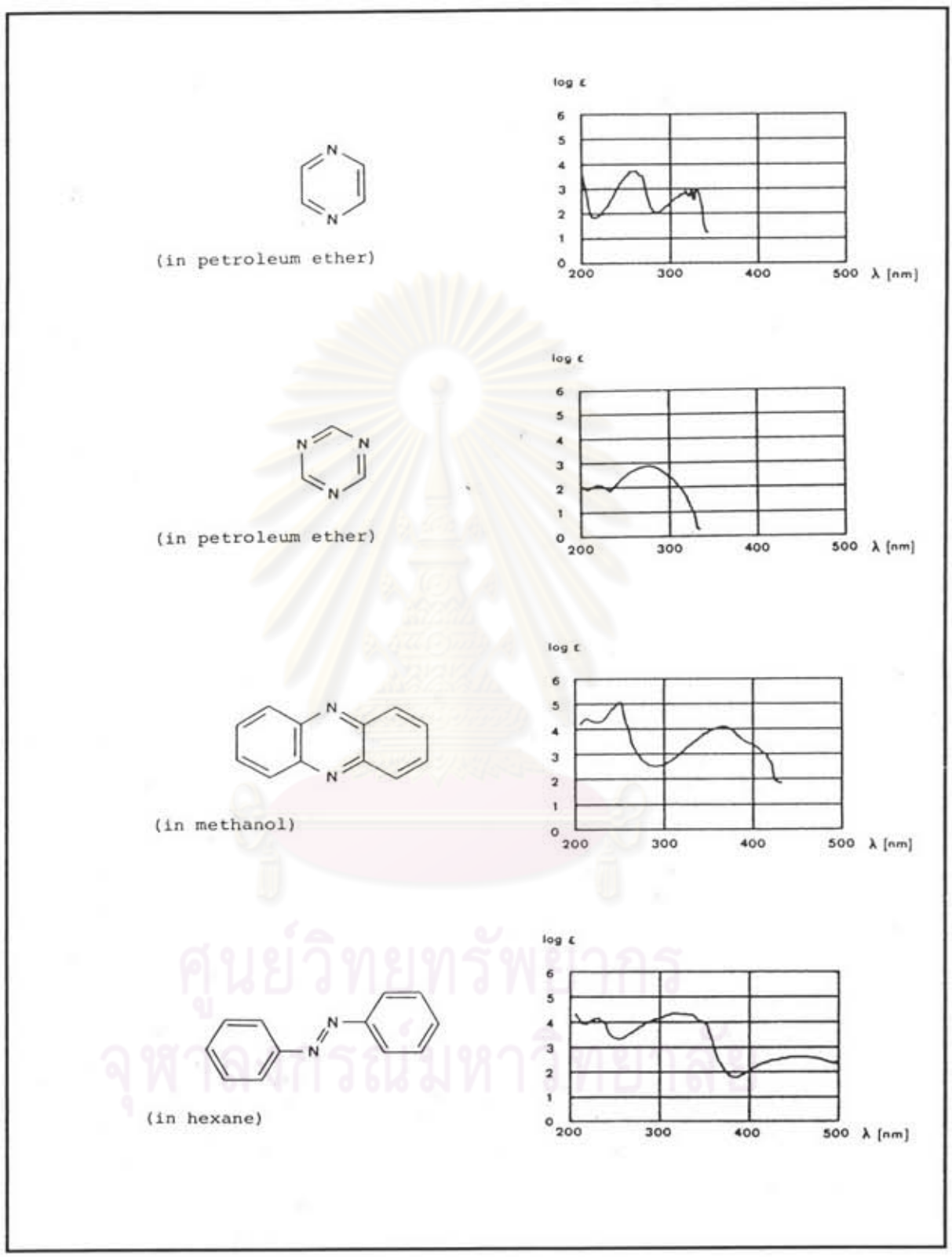

Figure A27 UV spectra of heterocyclic aromatic compounds with many nitrogen atoms in a molecule.

Figure A20 Photographs of **a)** light distillate **b)** dewaxed oil **c)** hydrodesulfurized oil **d)** white oil **e)** light oil **f)** Shell Risella white oil

VITA

Mr. Thumnoon Nhujak was born on January 9, 1970 in Trad. He received his Bachelor's Degree of Science in Chemistry from Chulalongkorn University in 1992. He has studied his Master in Petrochemistry, Multidisciplinary of Petrochemistry and Polymer, Graduate School, Chulalongkorn University, since 1992.