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APPENDIX

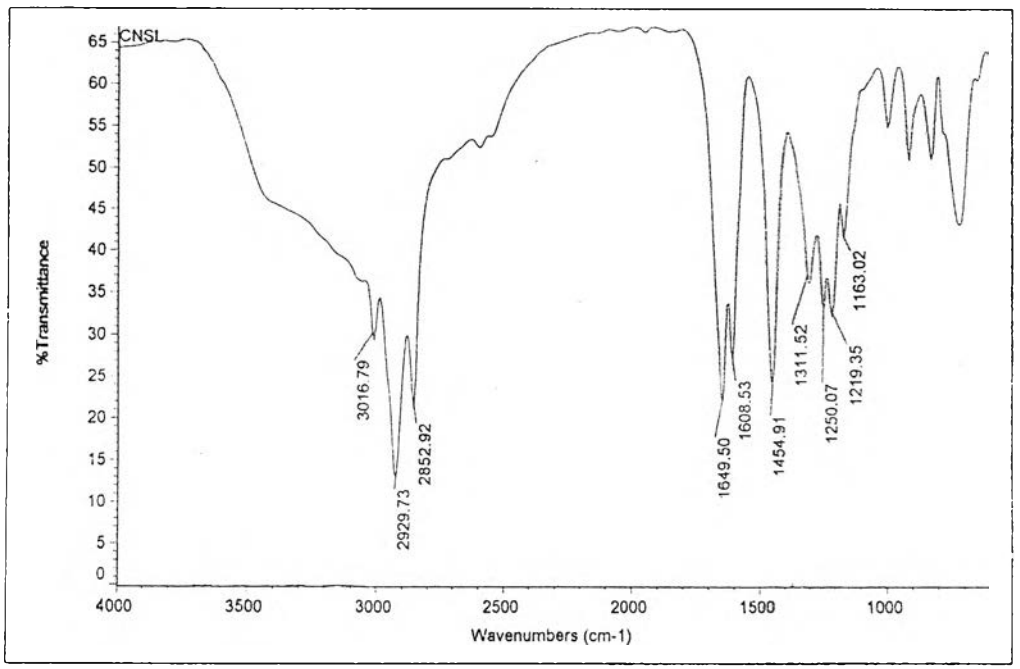

Fig. 4-1: Infrared spectrum of CNSL

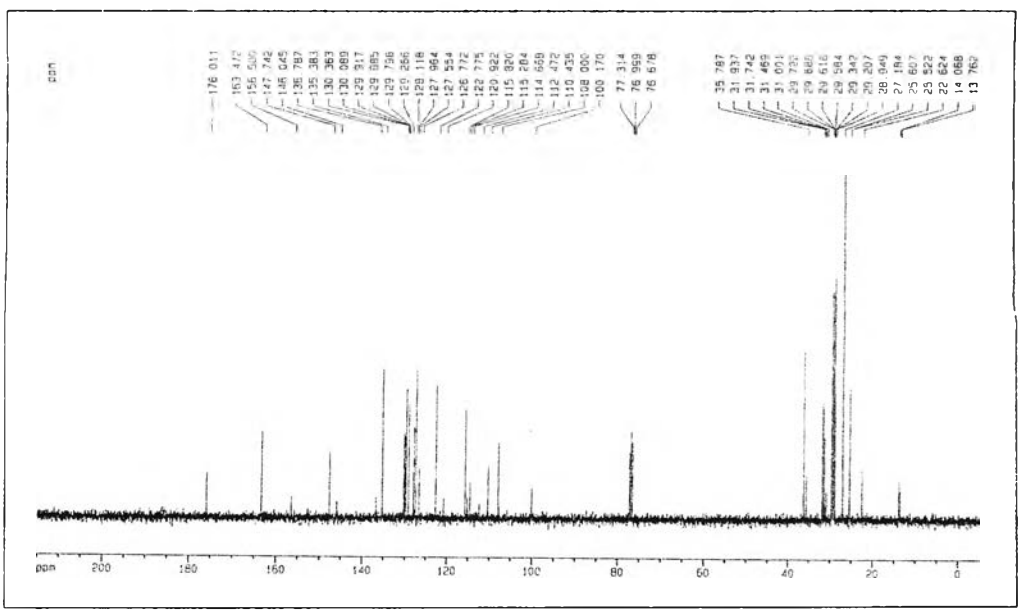

Fig. 4-2: ^{13}C-NMR spectrum of CNSL

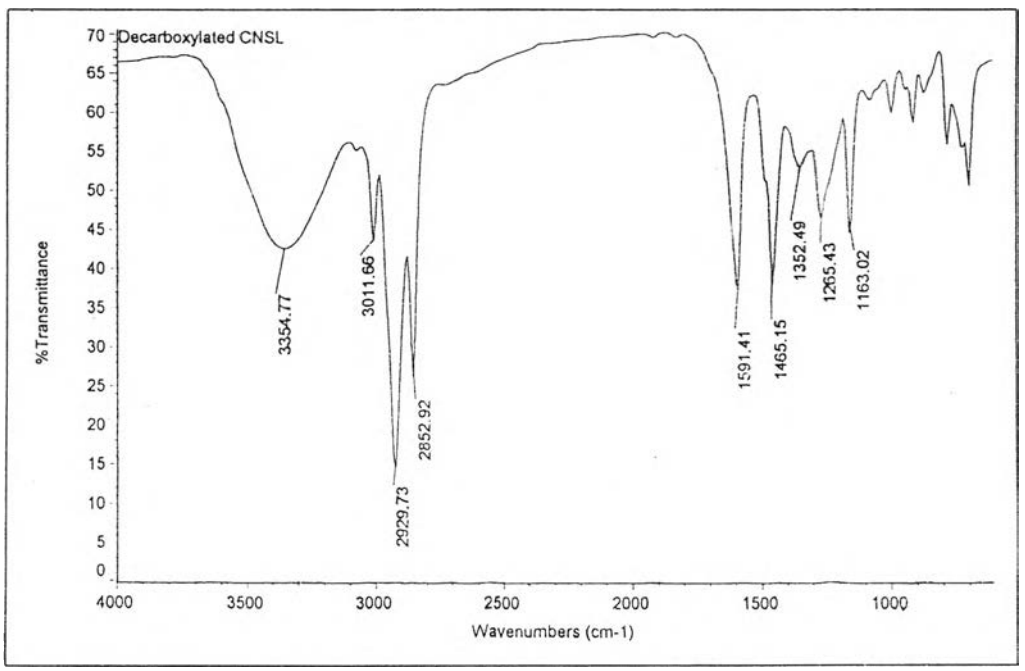

Fig. 4-3: Infrared spectrum of decarboxylated CNSL

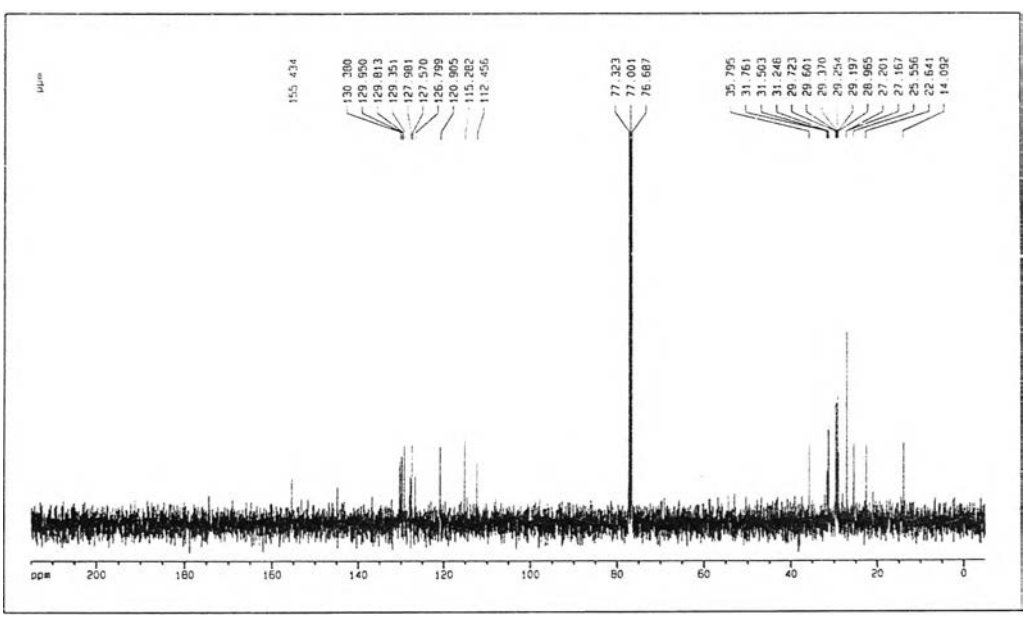

Fig. 4-4: ^{13}C-NMR spectrum of decarboxylated CNSL

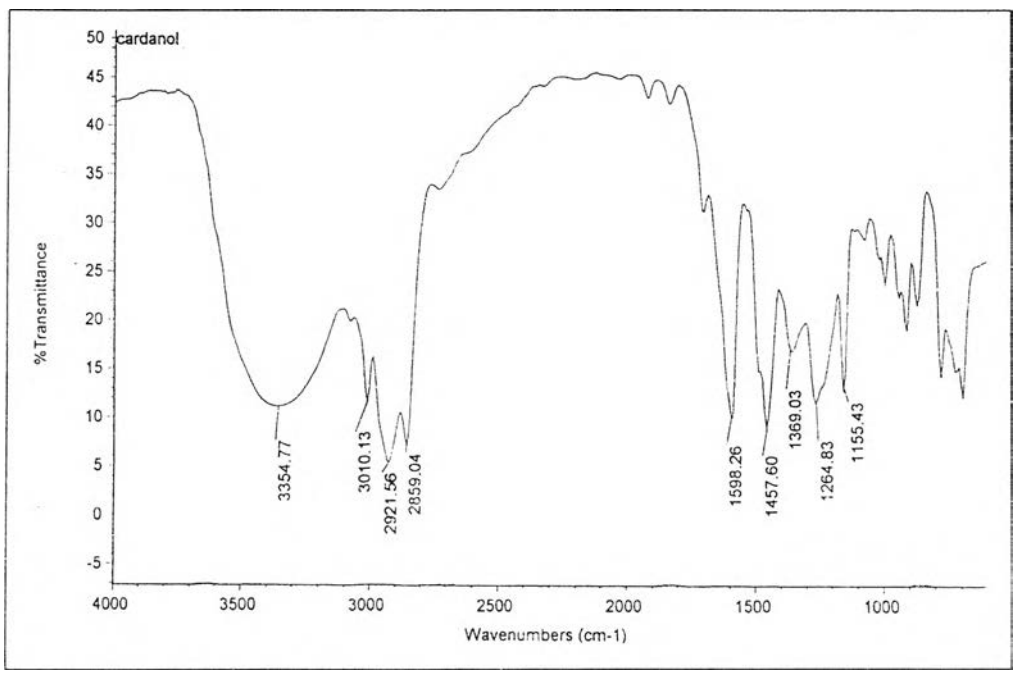

Fig. 4-5: Infrared spectrum of cardanol

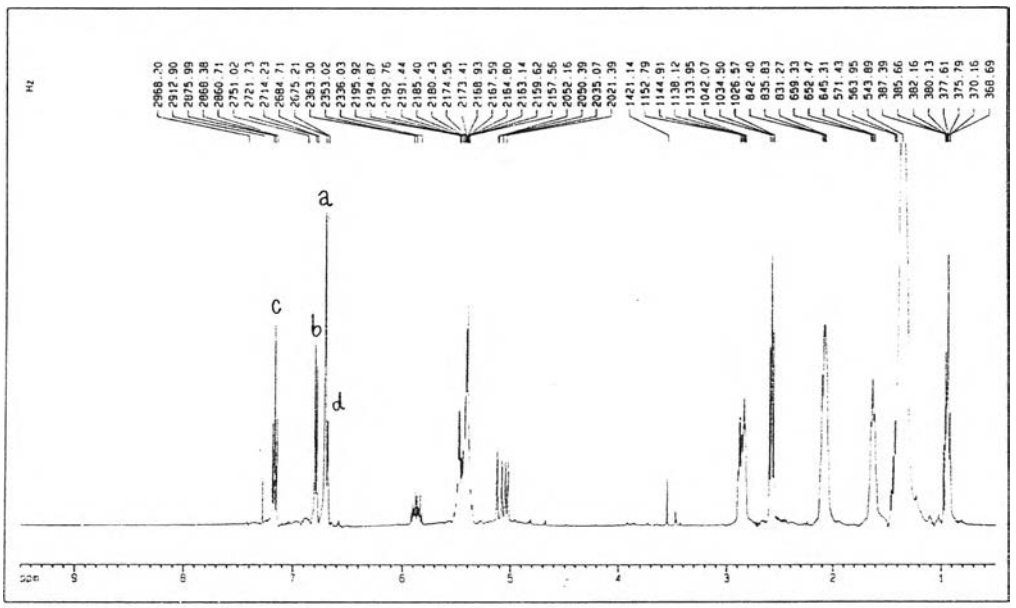

Fig. 4-6: ^{1}H-NMR spectrum of cardanol

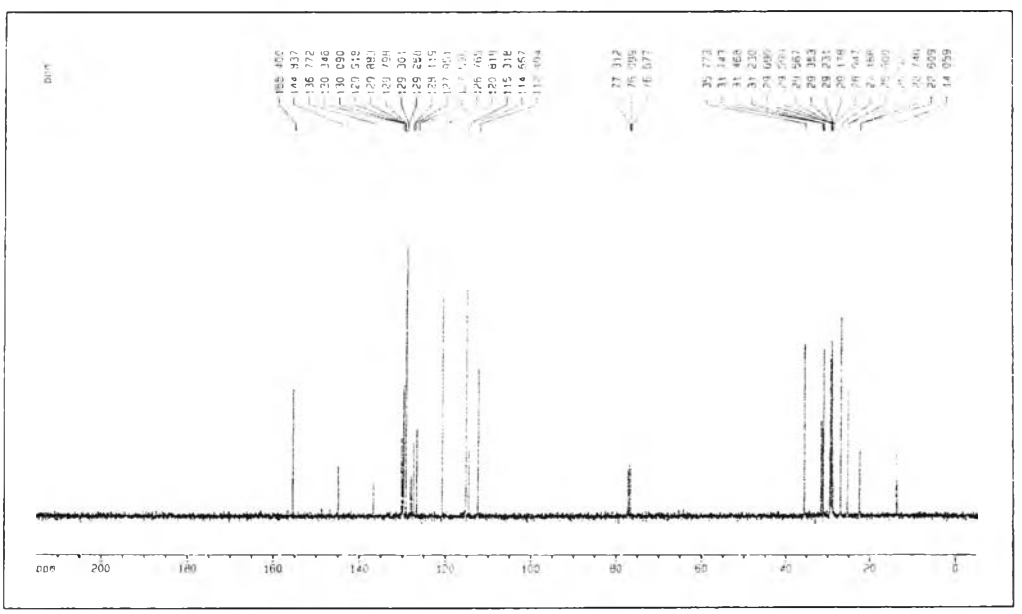

Fig. 4-7: ^{13}C-NMR spectrum of cardanol

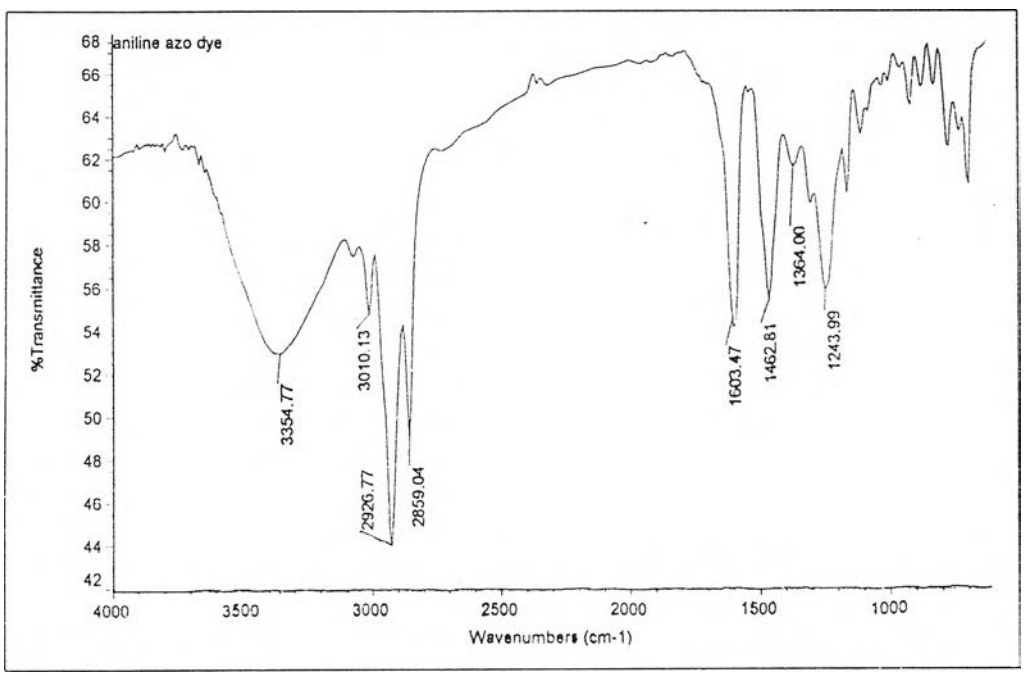

Fig. 4-8: Infrared spectrum of cardanol-phenyl azo

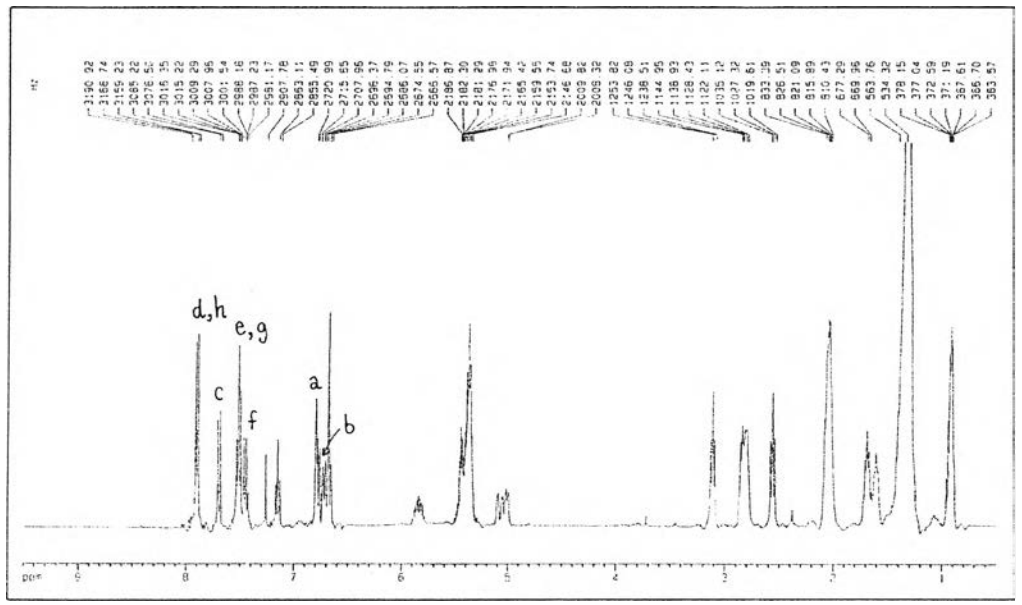

Fig. 4-9: ^{1}H-NMR spectrum of cardanol-phenyl azo

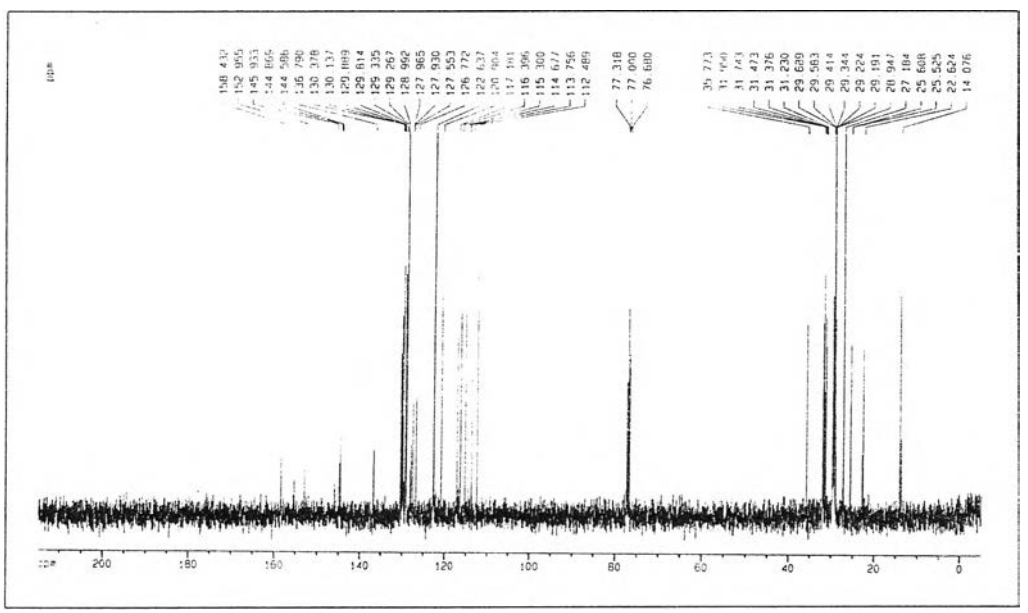

Fig. 4-10: ^{13}C-NMR spectrum of cardanol-phenyl azo

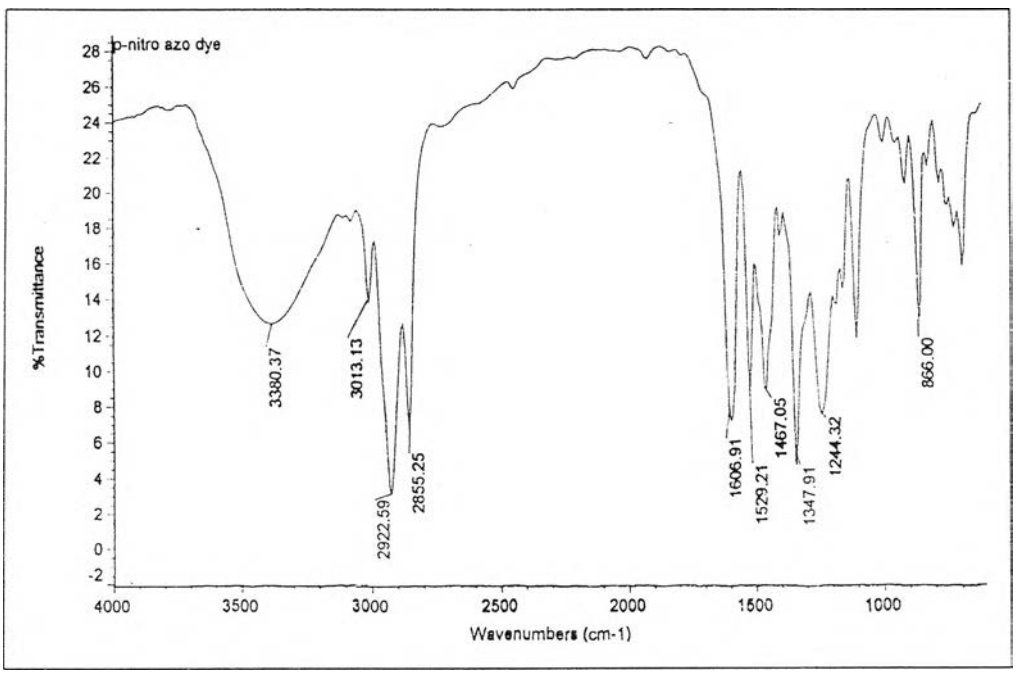

Fig. 4-11: Infrared spectrum of cardanol-*p*-nitrophenyl azo

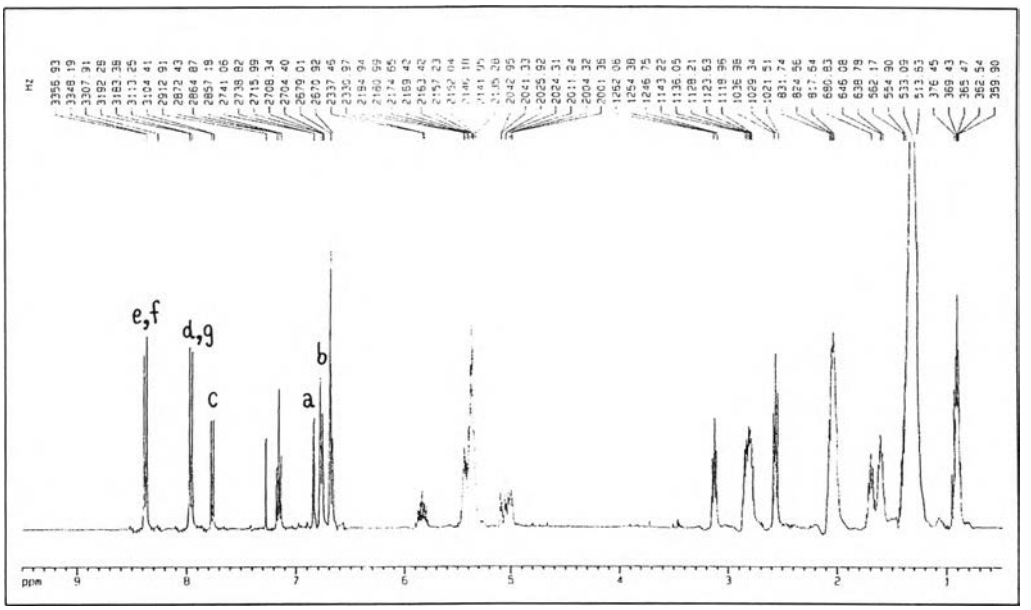

Fig. 4-12: ^{1}H-NMR spectrum of cardanol-*p*-nitrophenyl azo

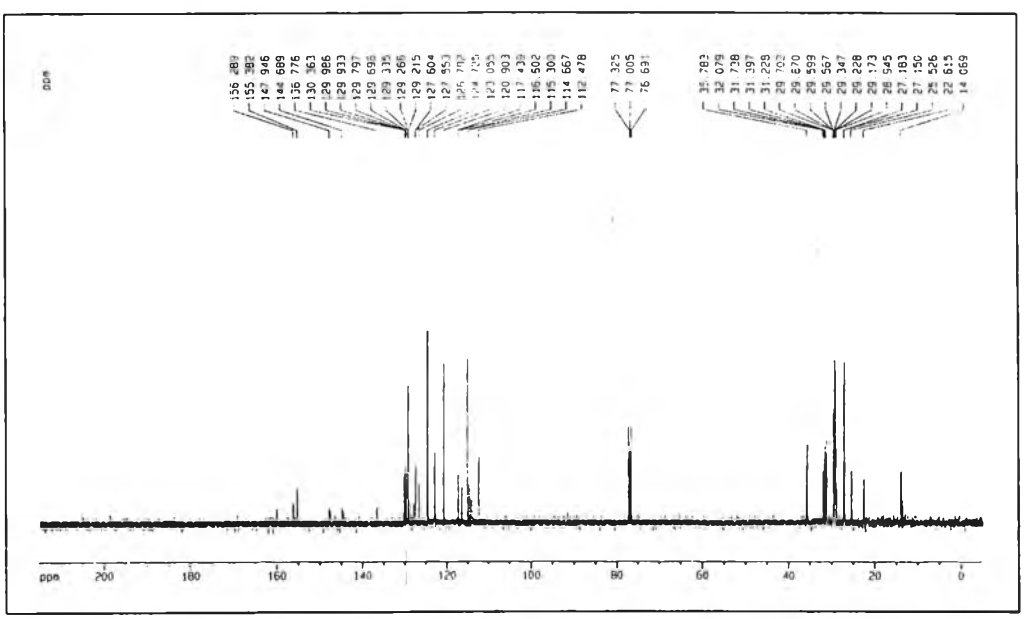

Fig. 4-13: ^{13}C-NMR spectrum of cardanol-*p*-nitrophenyl azo

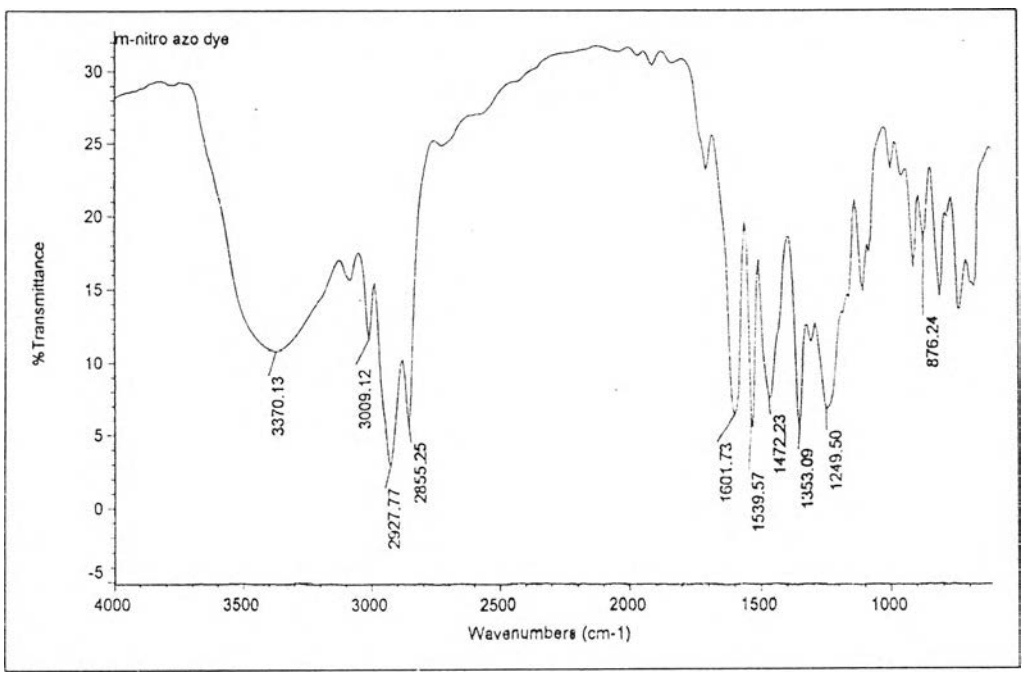

Fig. 4-14: Infrared spectrum of cardanol-*m*-nitrophenyl azo

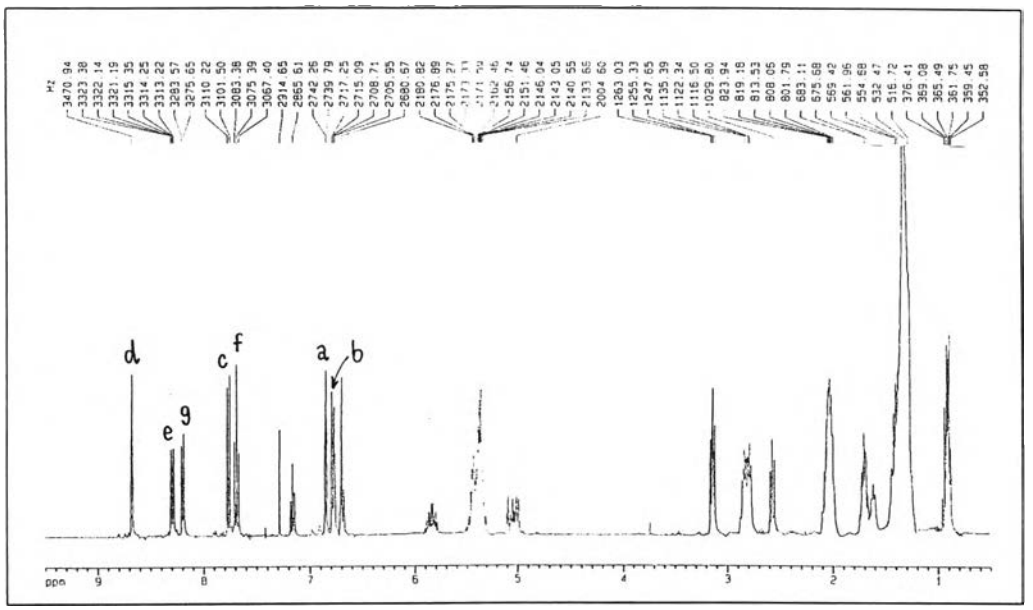

Fig. 4-15: ^{1}H-NMR spectrum of cardanol-*m*-nitrophenyl

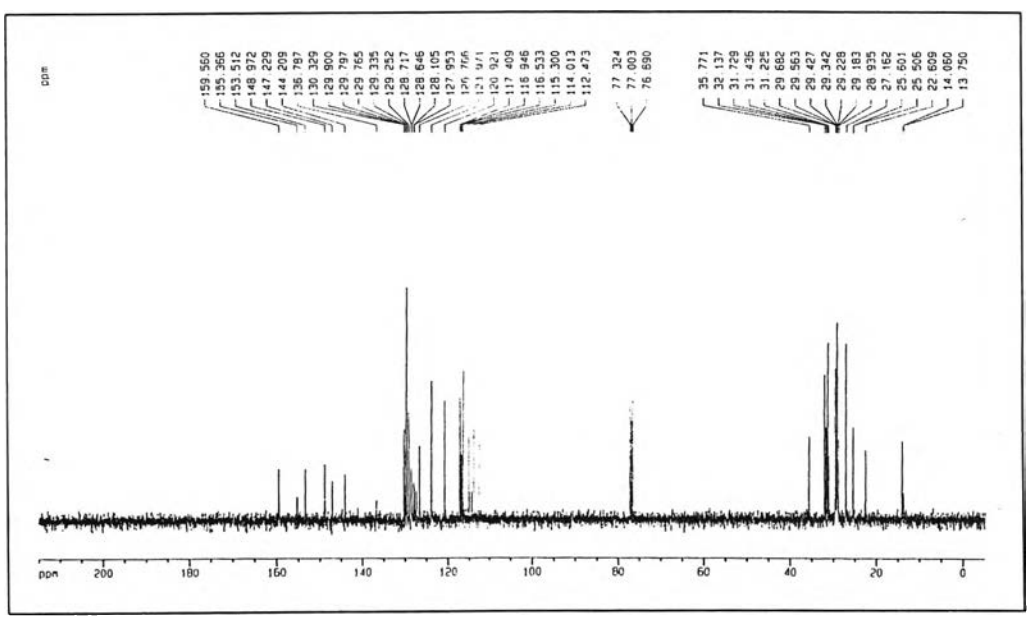

Fig. 4-16: ^{13}C-NMR spectrum of cardanol-*m*-nitrophenyl

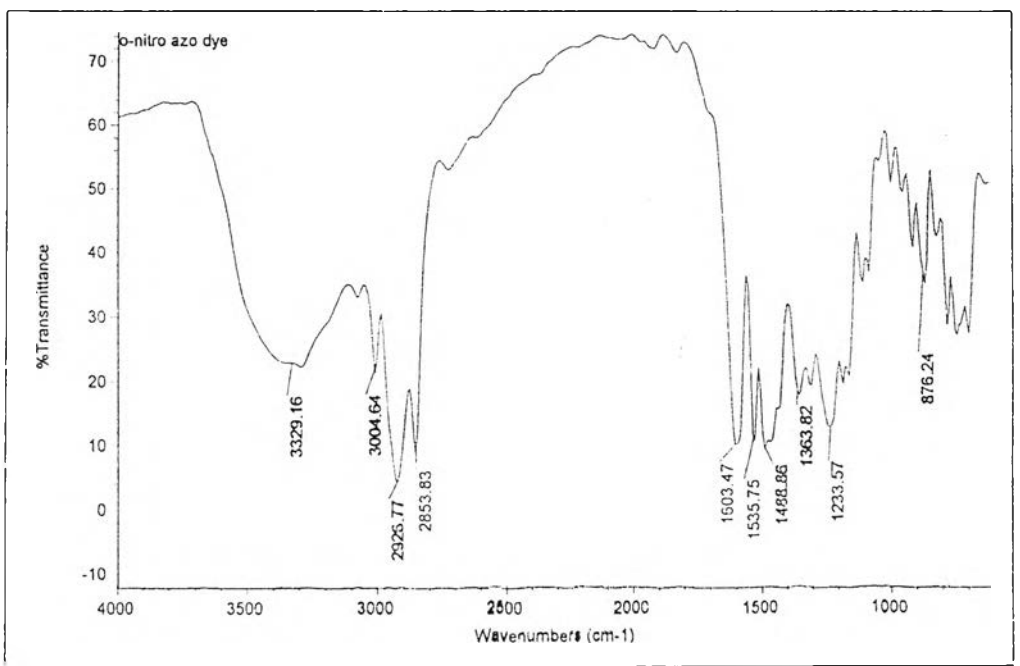

Fig. 4-17: Infrared spectrum of cardanol-*o*-nitrophenyl azo

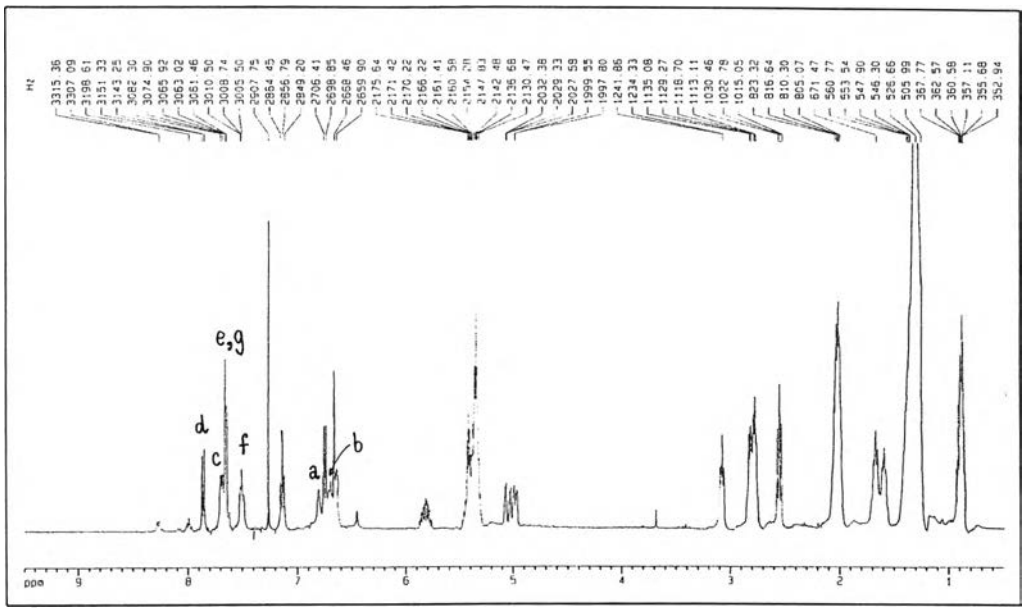

Fig. 4-18: ^{1}H-NMR spectrum of cardanol-*o*-nitrophenyl azo

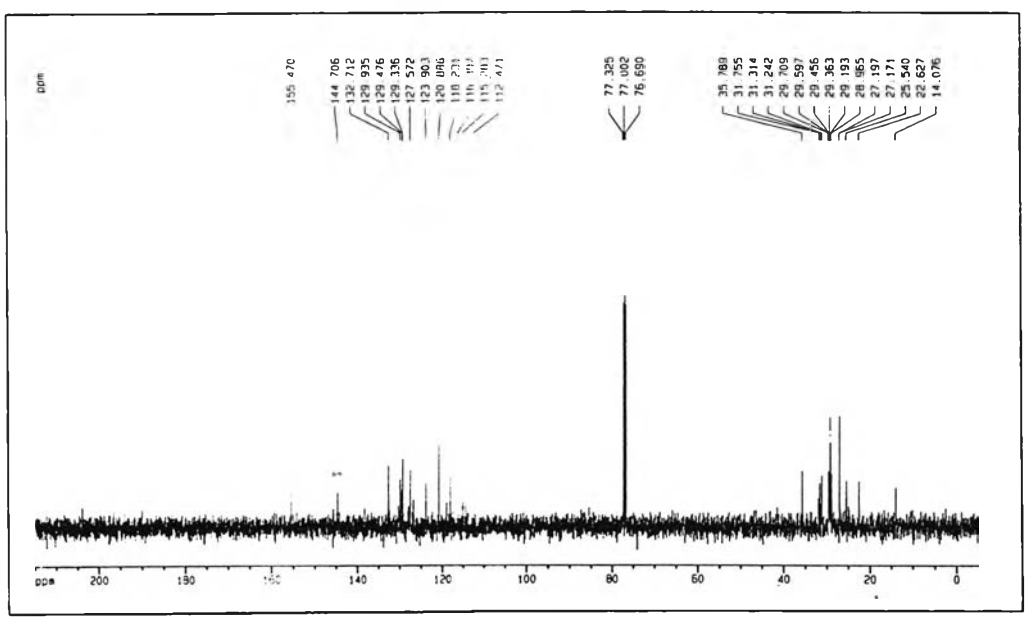

Fig. 4-19: ^{13}C-NMR spectrum of cardanol-*o*-nitrophenyl azo

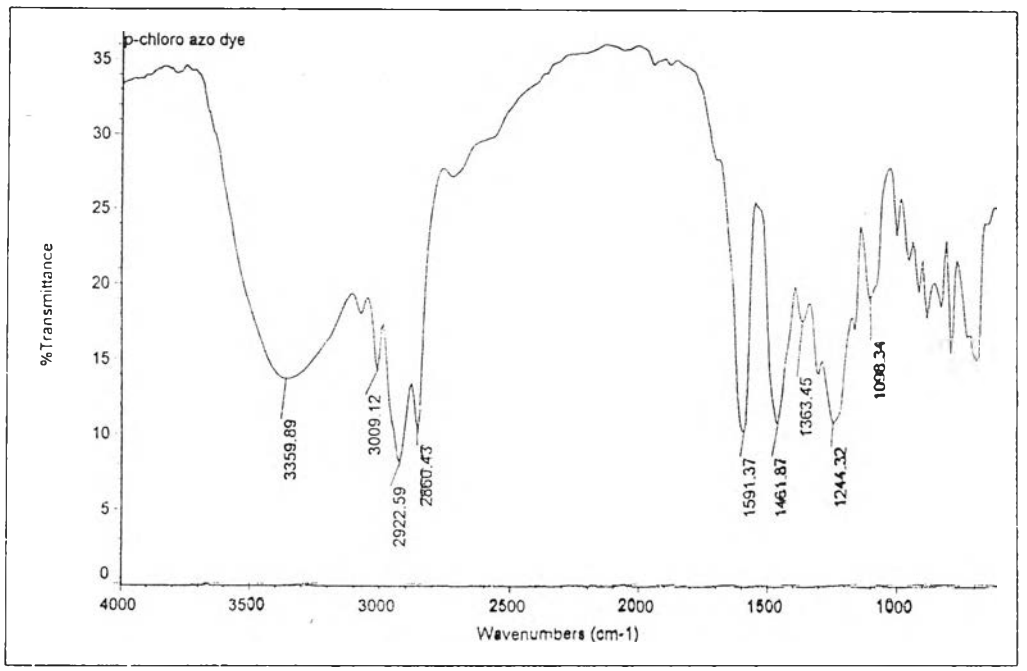

Fig. 4-20: Infrared spectrum of cardanol-*p*-chlorophenyl azo

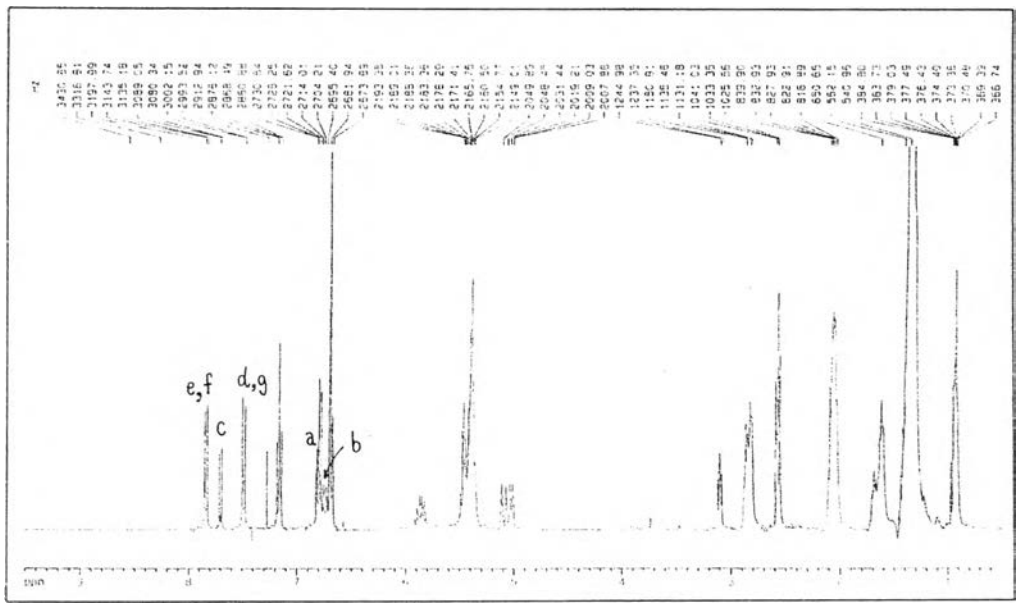

Fig. 4-21: ^{1}H-NMR spectrum of cardanol-*p*-chlorophenyl azo

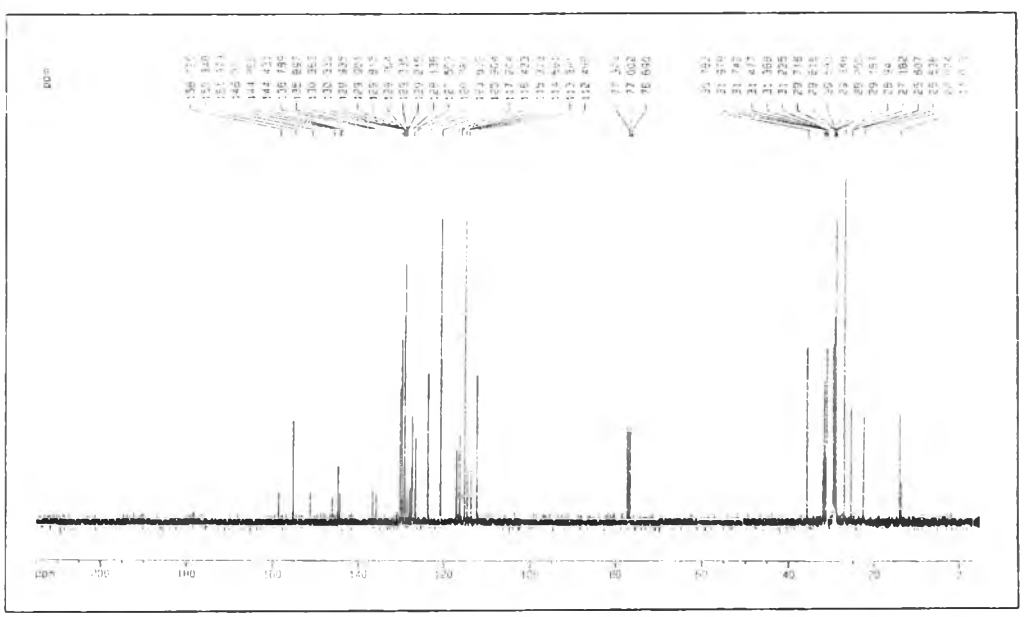

Fig. 4-22: ^{13}C-NMR spectrum of cardanol-*p*-chlorophenyl azo

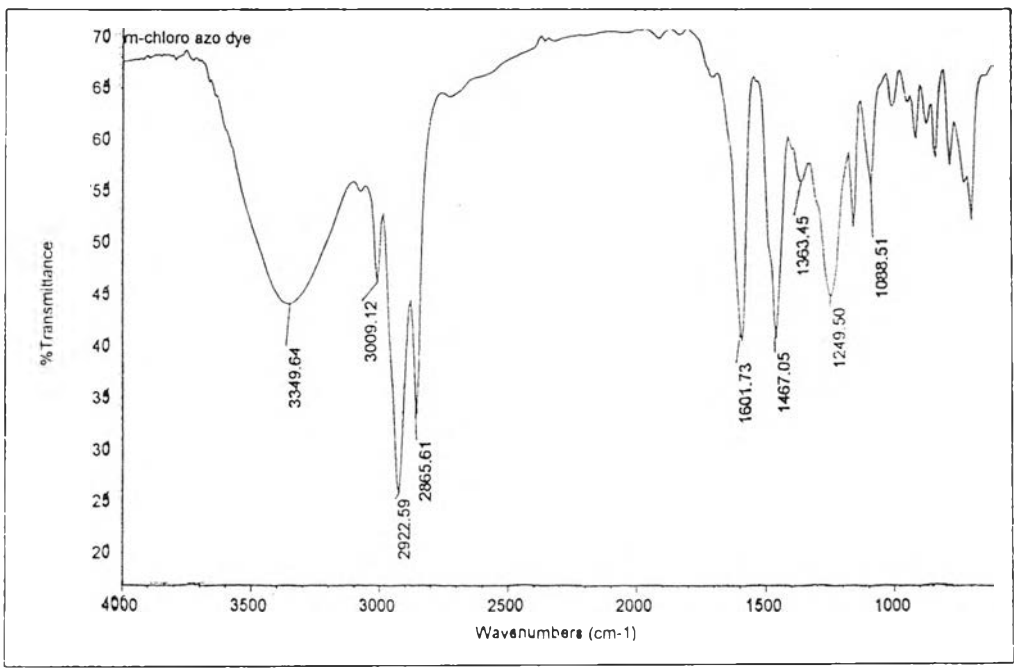

Fig. 4-23: Infrared spectrum of cardanol-*m*-chlorophenyl azo

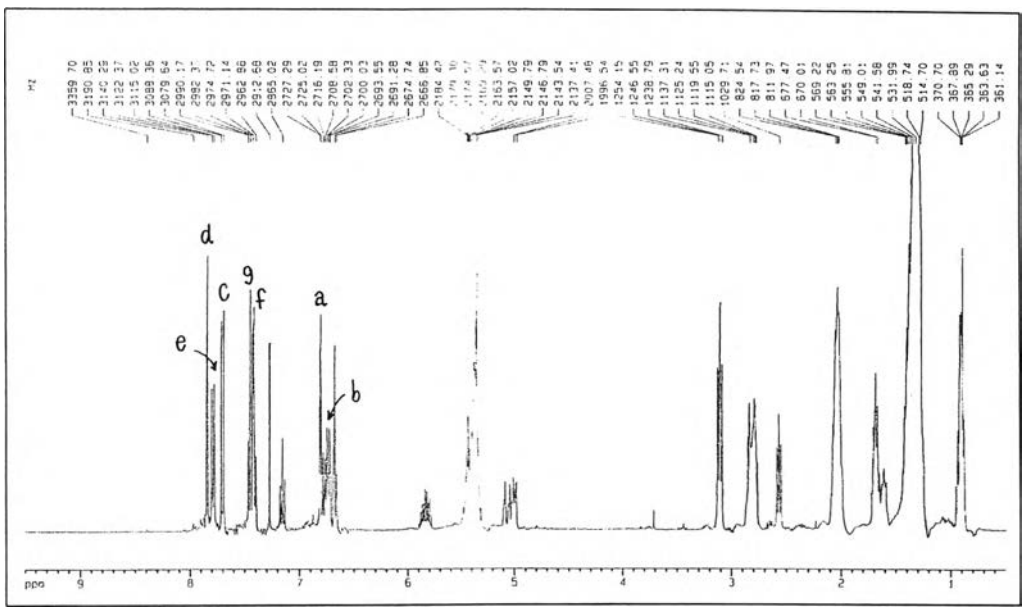

Fig. 4-24: ^{1}H-NMR spectrum of cardanol-*m*-chlorophenyl azo

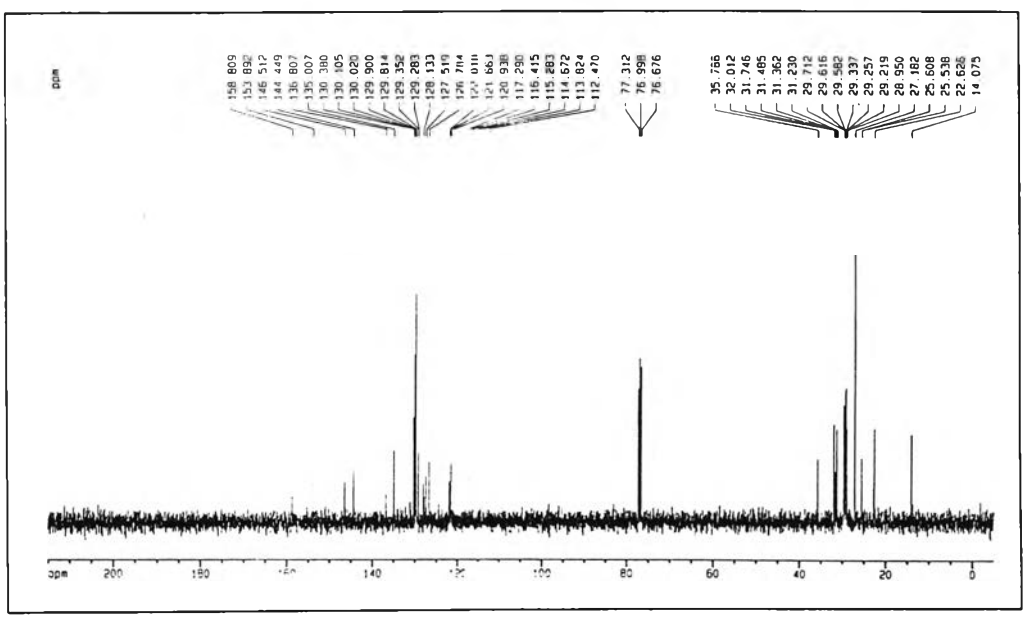

Fig. 4-25: ^{13}C-NMR spectrum of cardanol-*m*-chlorophenyl

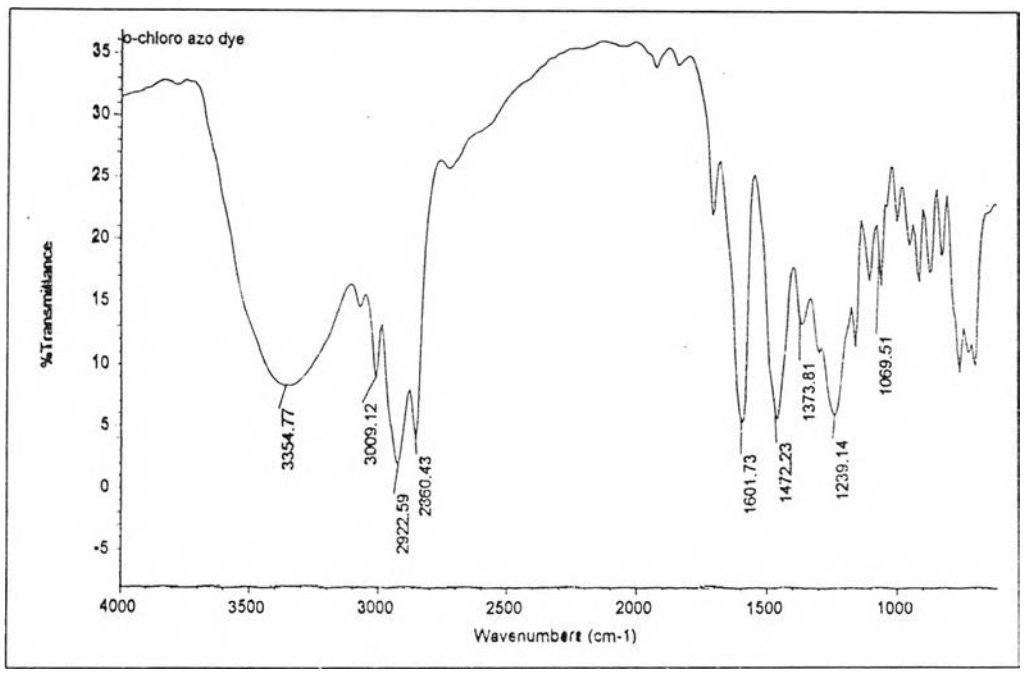

Fig. 4-26: Infrared spectrum of cardanol-*o*-chlorophenyl azo

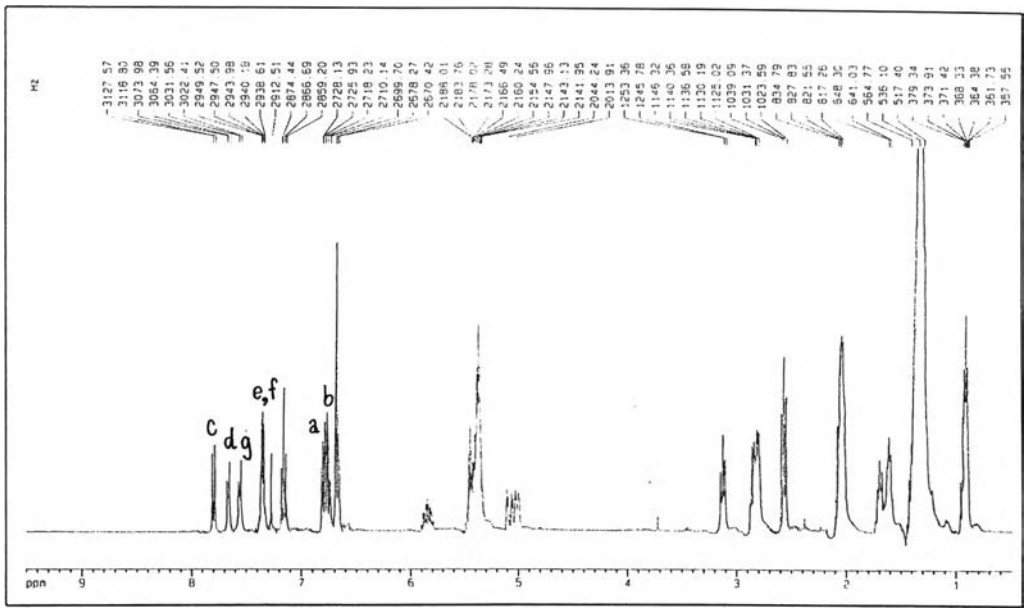

Fig. 4-27: ^{1}H-NMR spectrum of cardanol-*o*-chlorophenyl azo

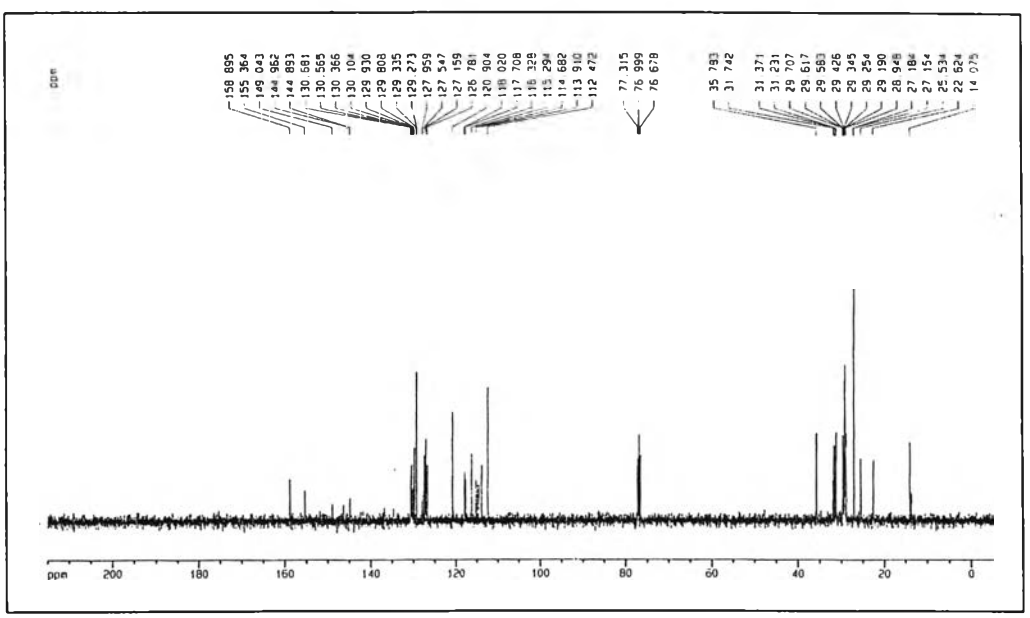

Fig. 4-28: ^{13}C-NMR spectrum of cardanol-*o*-chlorophenyl azo

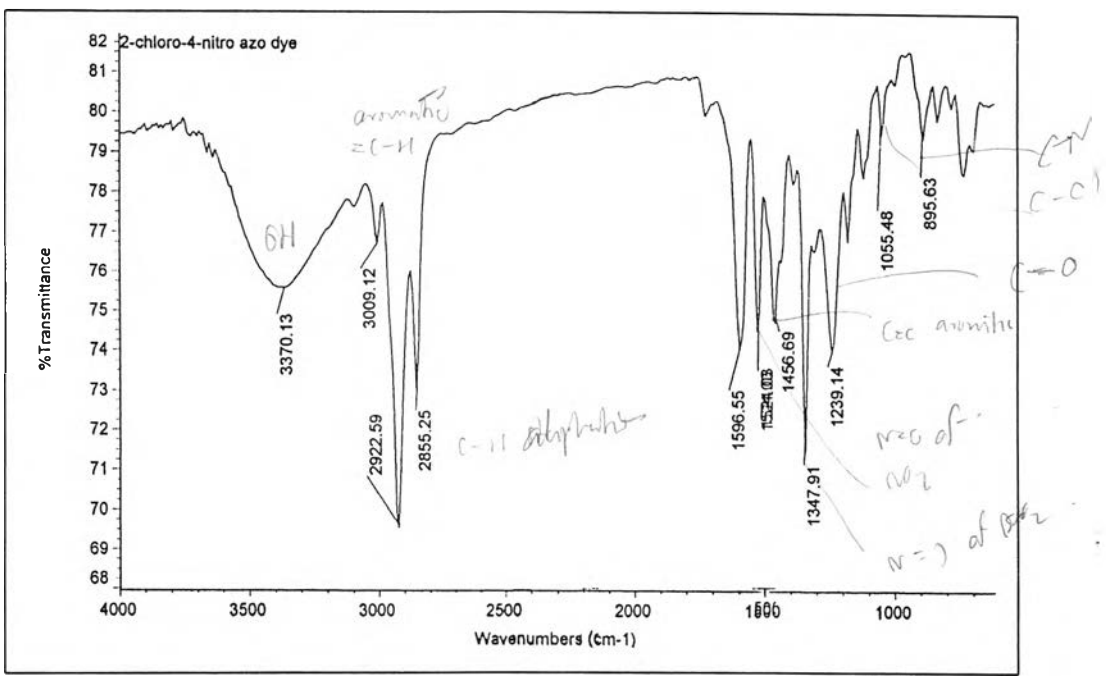

Fig. 4-29: Infrared spectrum of cardanol-2-chloro-4-nitrophenyl azo

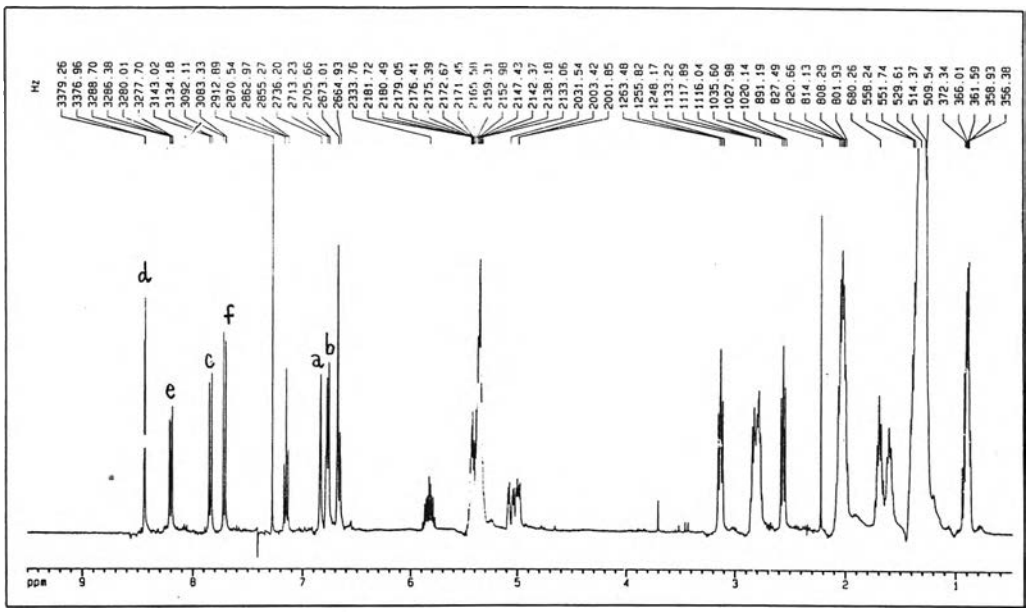

Fig. 4-30: ^{1}H-NMR spectrum of cardanol-2-chloro-4-nitrophenyl azo

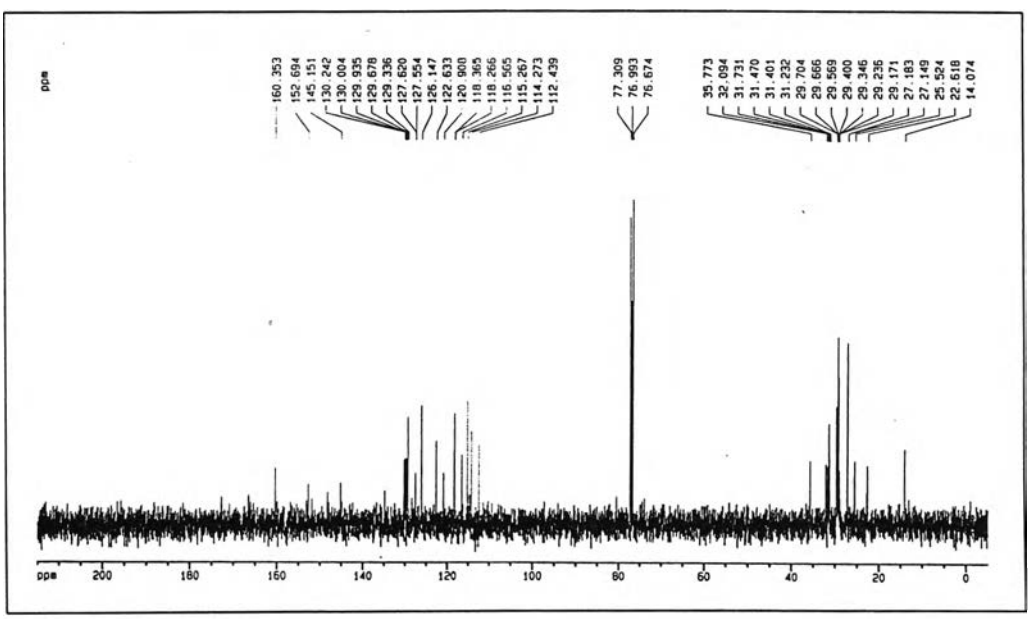

Fig. 4-31: ^{13}C-NMR spectrum of cardanol-2-chloro-4-nitrophenyl azo

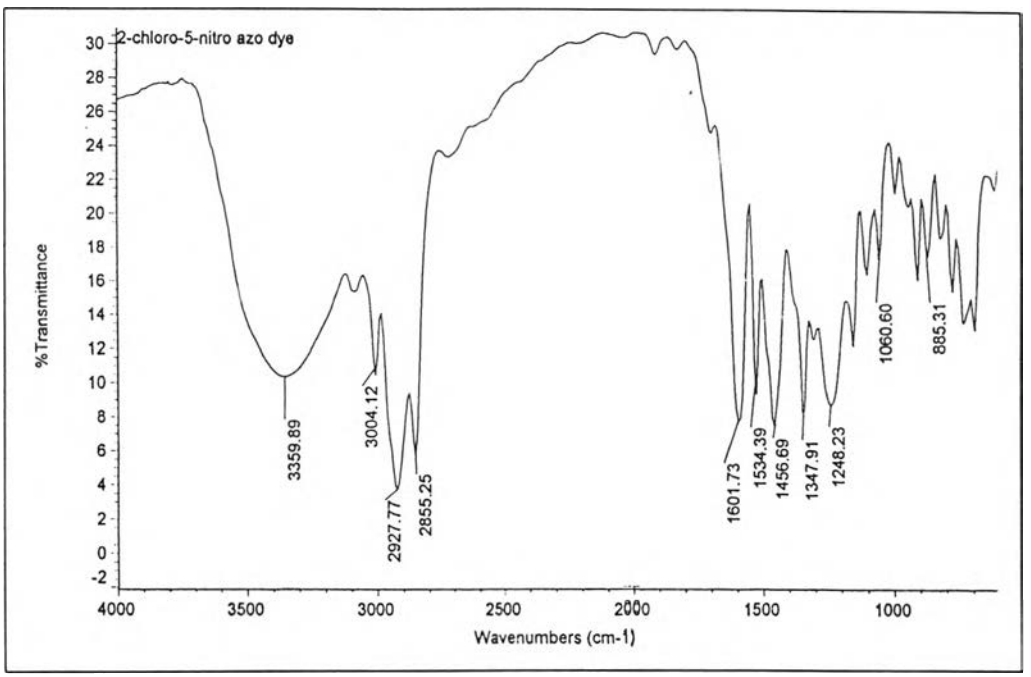

Fig. 4-32: Infrared spectrum of cardanol-2-chloro-5-nitrophenyl azo

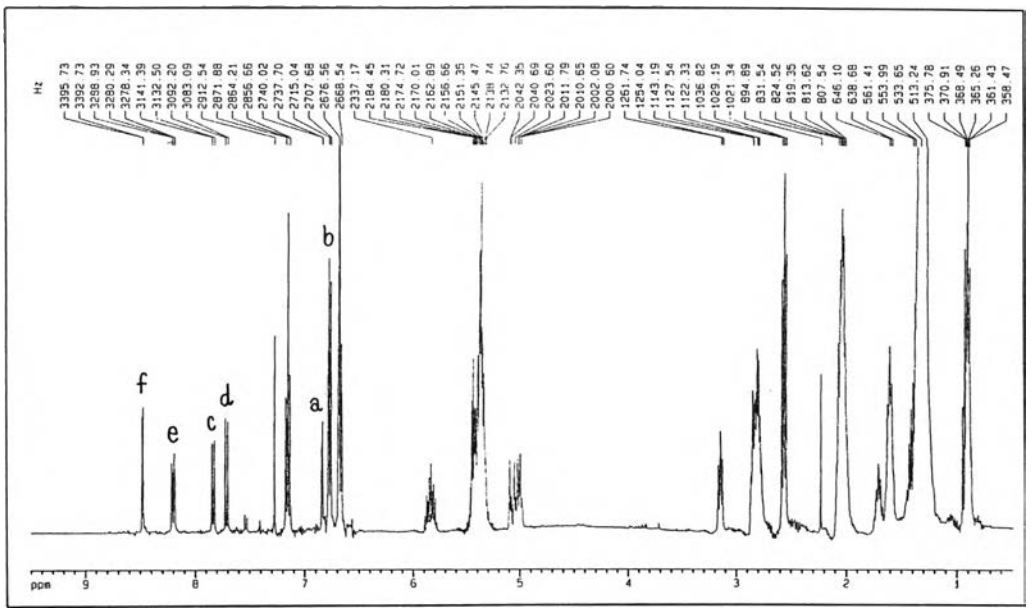

Fig. 4-33: ^{1}H-NMR spectrum of cardanol-2-chloro-5-nitrophenyl azo

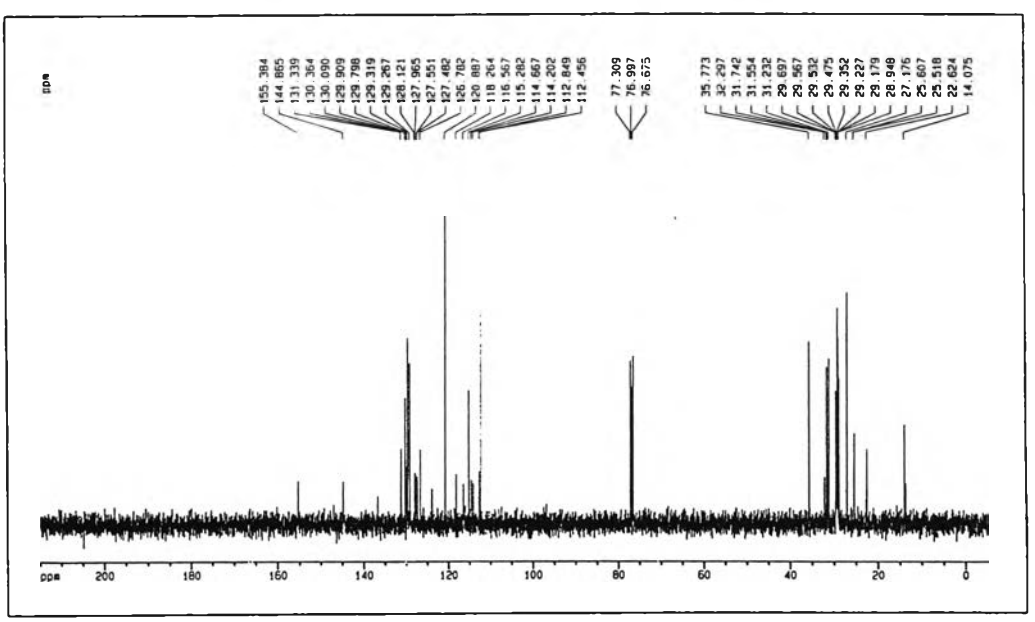

Fig. 4-34: ^{13}C-NMR spectrum of cardanol-2-chloro-5-nitrophenyl azo

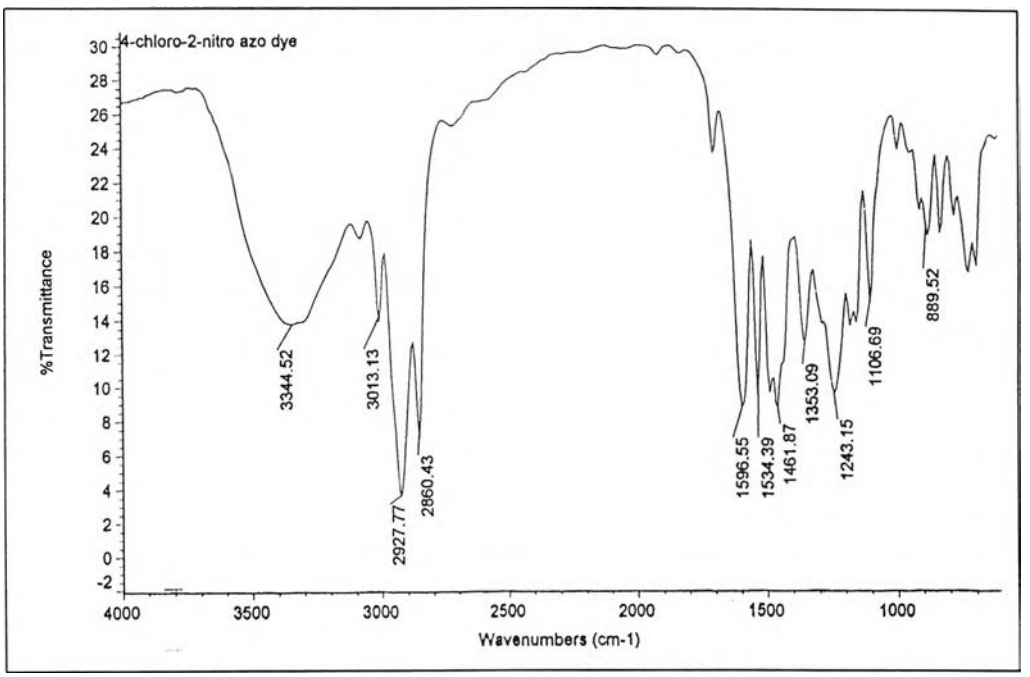

Fig. 4-35: Infrared spectrum of cardanol-4-chloro-2-nitrophenyl azo

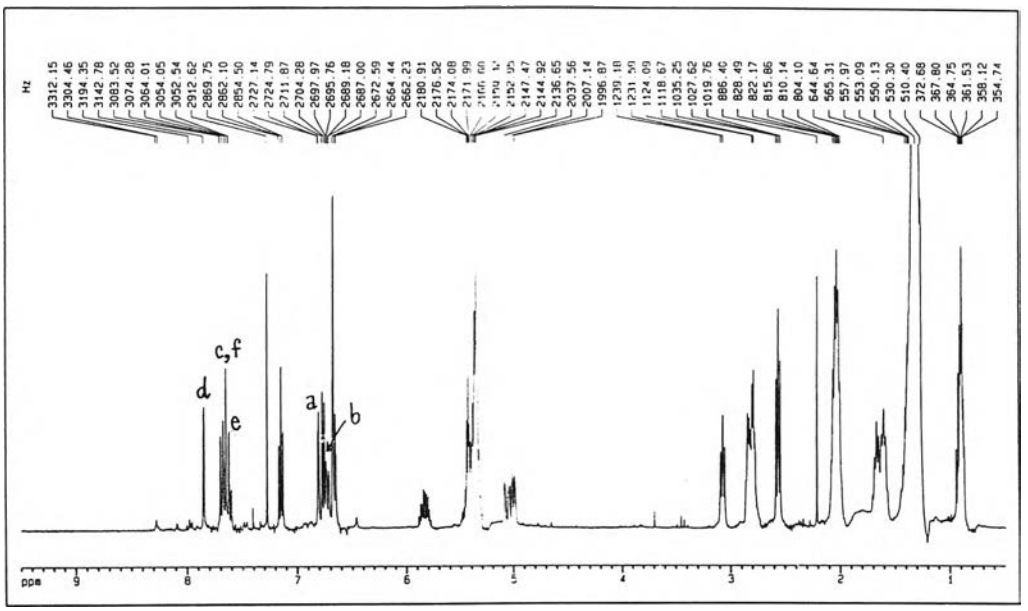

Fig. 4-36: ^{1}H-NMR spectrum of cardanol-4-chloro-2-nitrophenyl azo

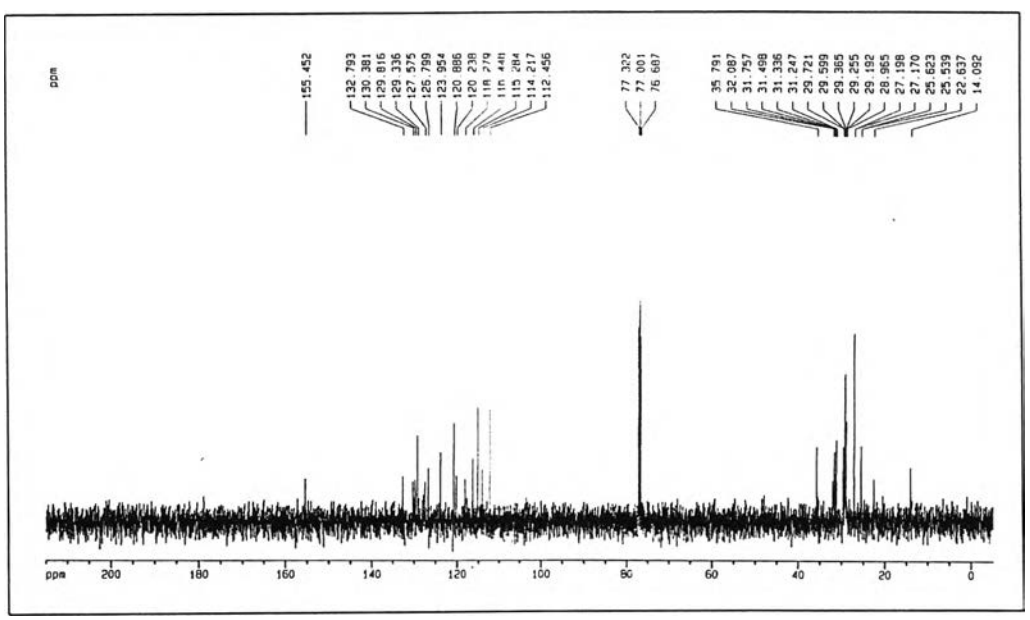

Fig. 4-37: ^{13}C-NMR spectrum of cardanol-4-chloro-2-nitrophenyl azo

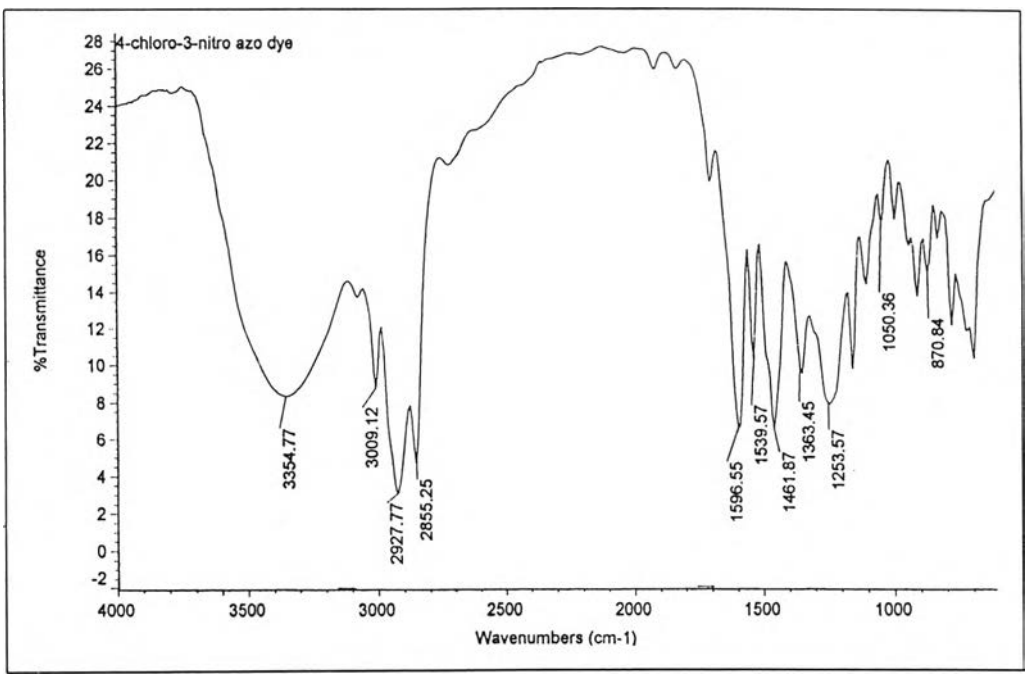

Fig. 4-38: Infrared spectrum of cardanol-4-chloro-3-nitrophenyl azo

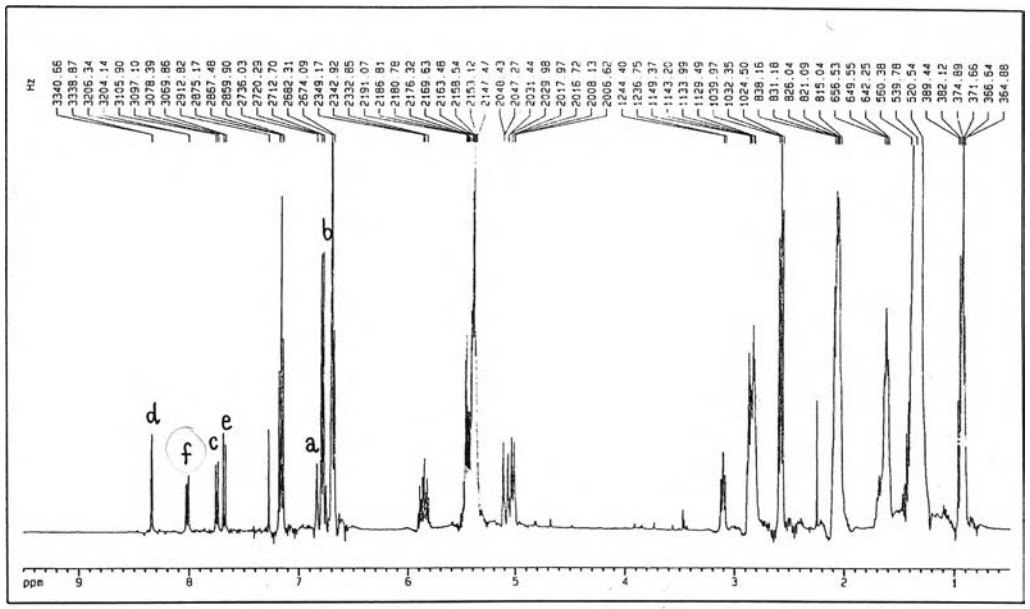

Fig. 4-39: ^{1}H-NMR spectrum of cardanol-4-chloro-3-nitrophenyl azo

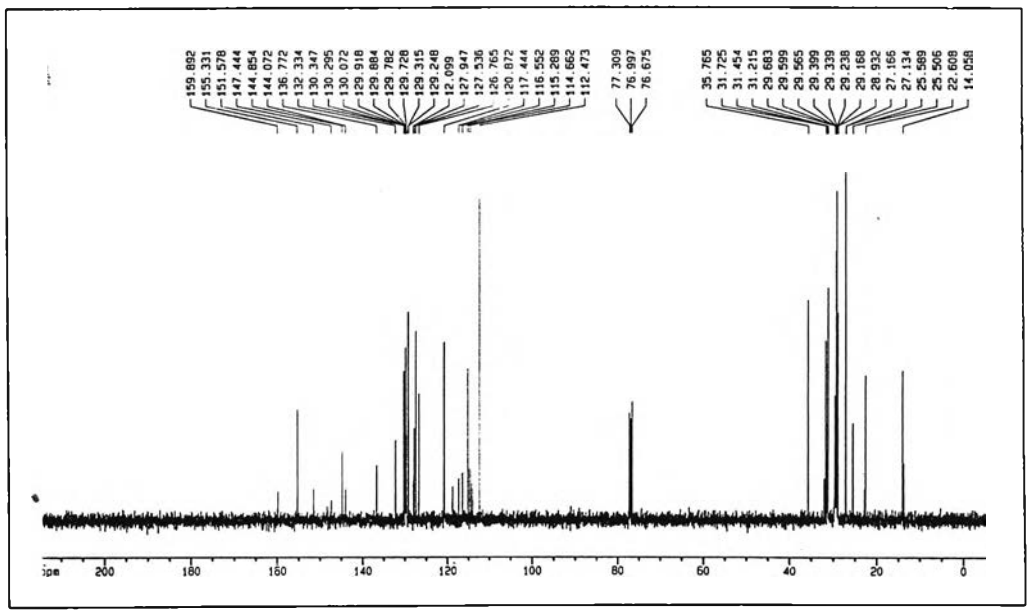

Fig. 4-40: ^{13}C-NMR spectrum of cardanol-4-chloro-3-nitrophenyl azo

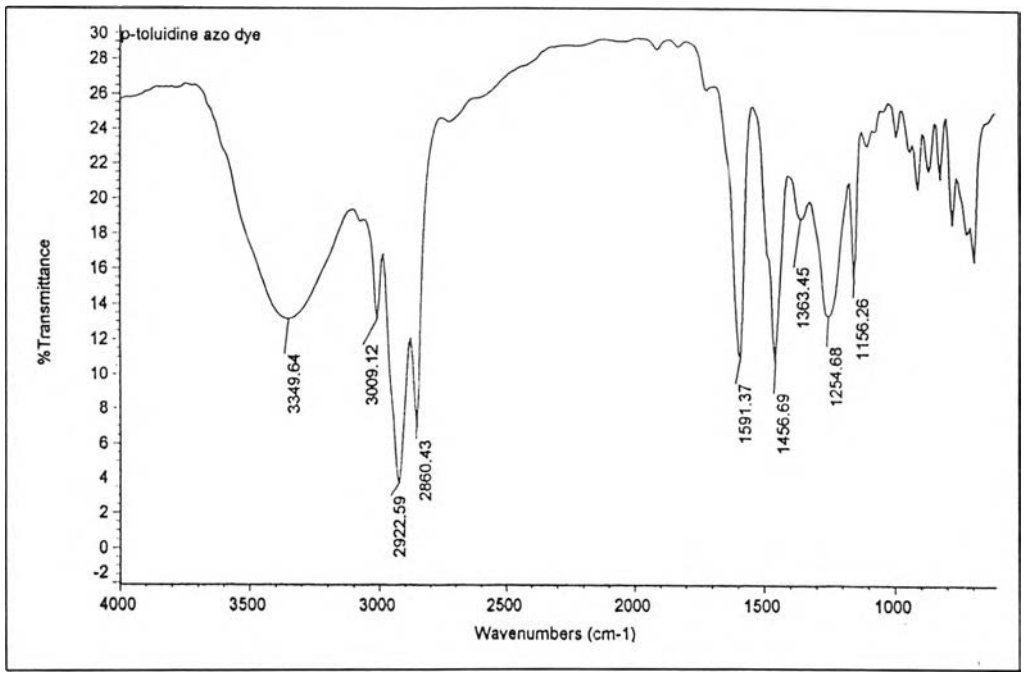

Fig. 4-41: Infrared spectrum of cardanol-*p*-methylphenyl azo

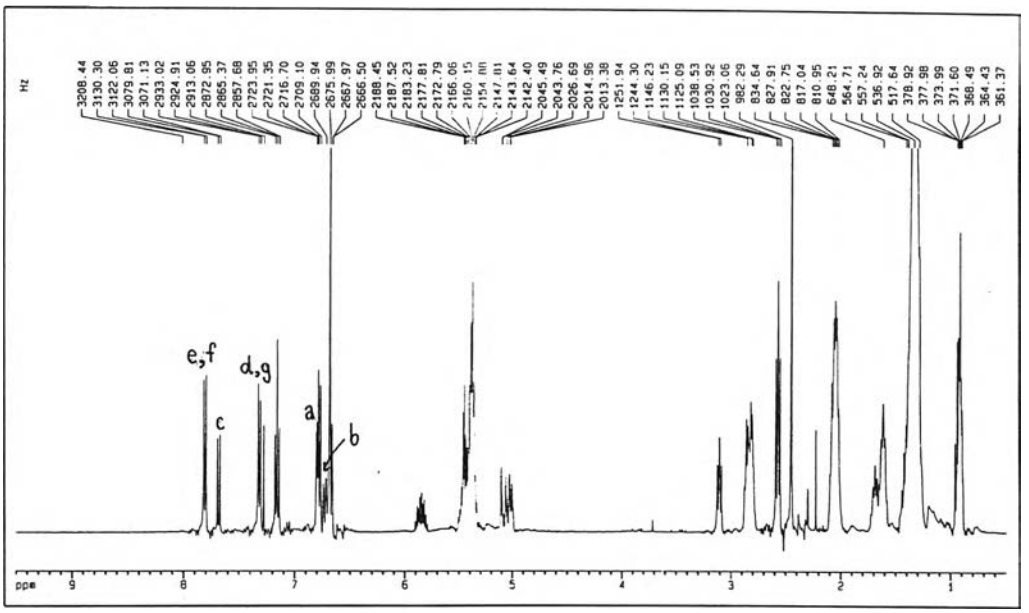

Fig. 4-42: ^{1}H-NMR spectrum of cardanol-*p*-methylphenyl azo

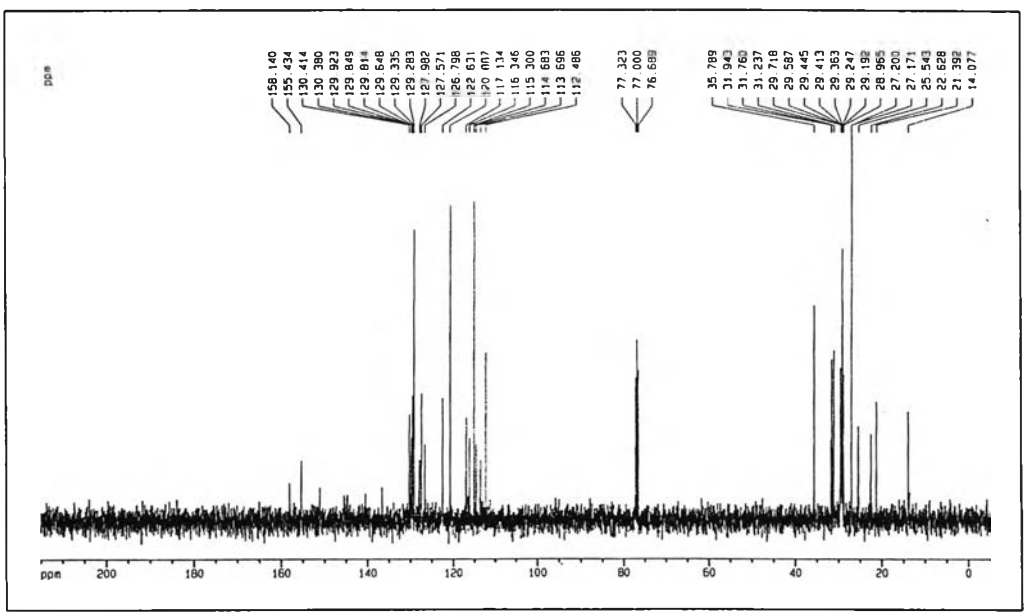

Fig. 4-43: ^{13}C-NMR spectrum of cardanol-*p*-methylphenyl azo

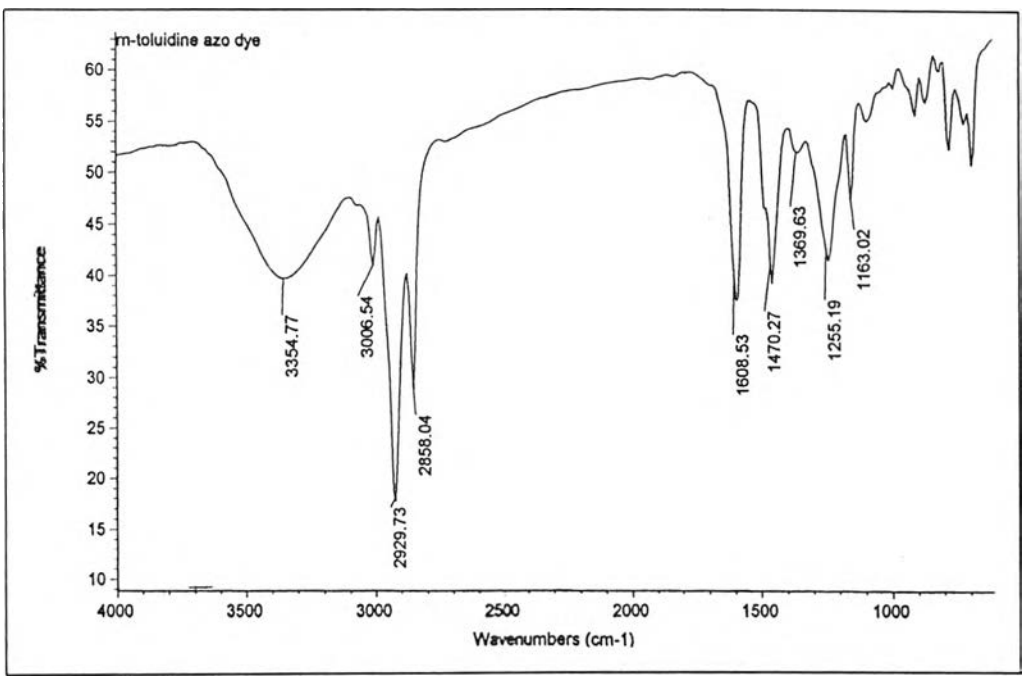

Fig. 4-44: Infrared spectrum of cardanol-*m*-methylphenyl azo

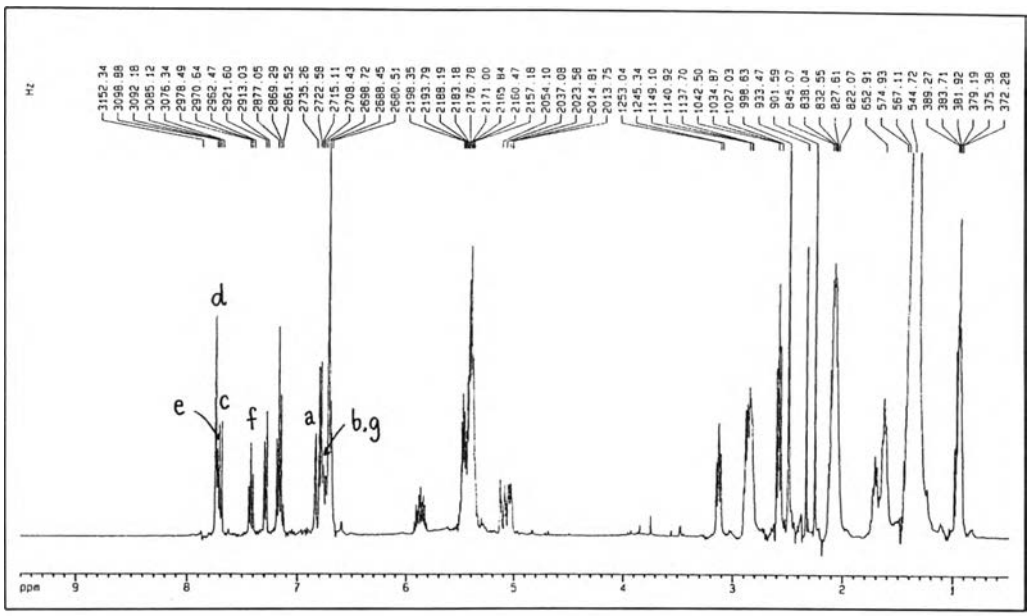

Fig. 4-45: ^{1}H-NMR spectrum of cardanol-*m*-methylphenyl azo

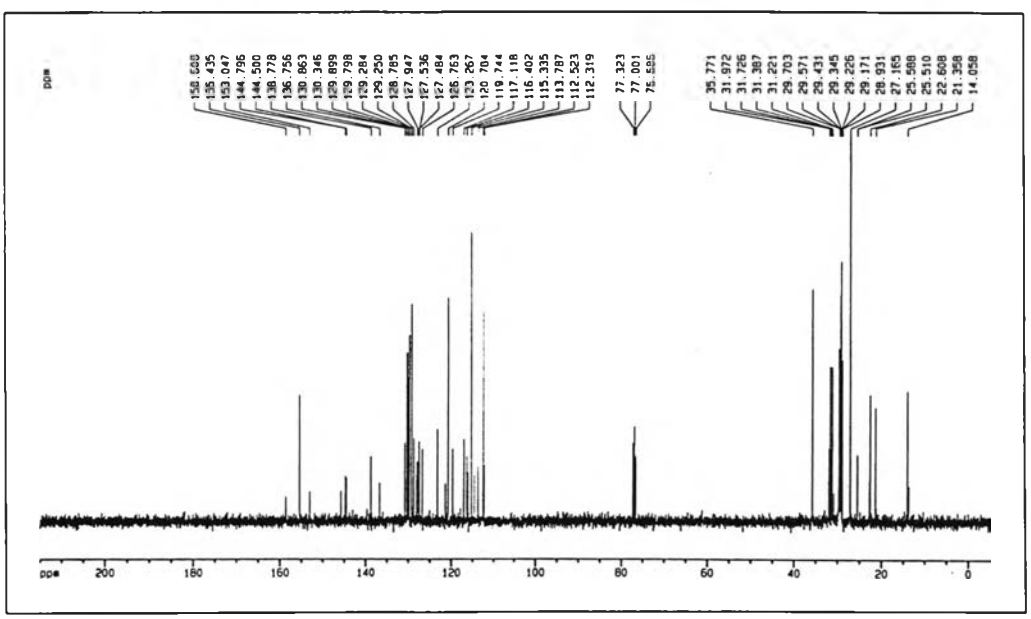

Fig. 4-46: ^{13}C-NMR spectrum of cardanol-*m*-methylphenyl azo

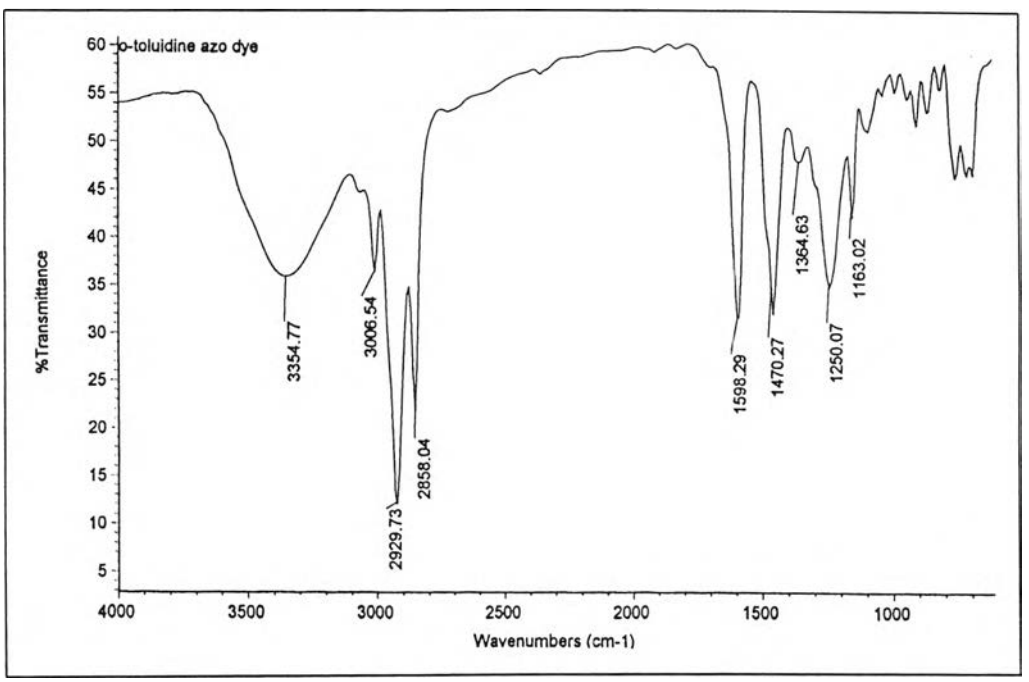

Fig. 4-47: Infrared spectrum of cardanol-*o*-methylphenyl azo

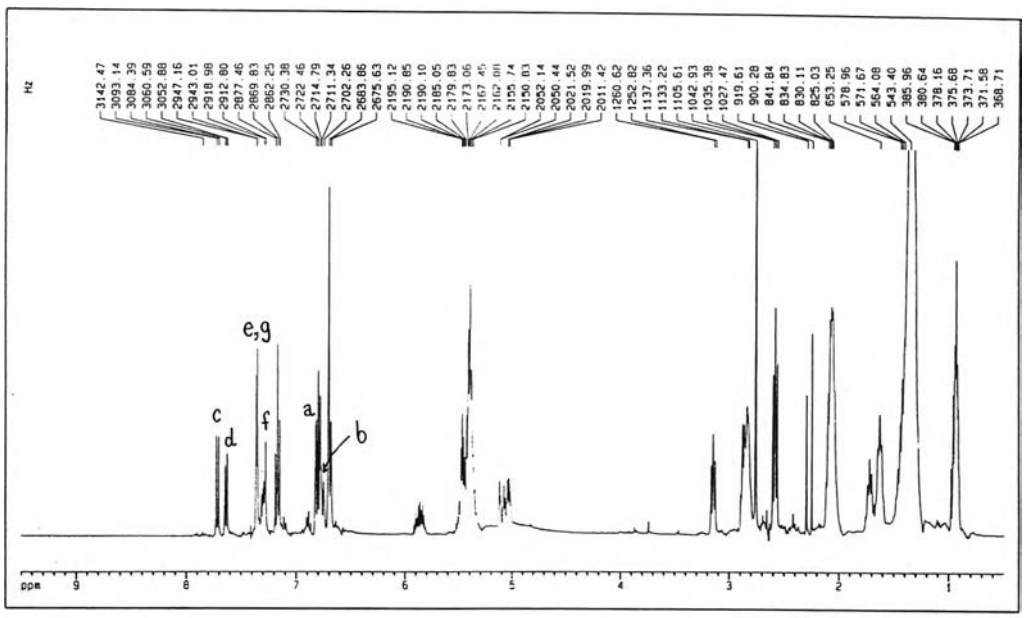

Fig. 4-48: ^{1}H-NMR spectrum of cardanol-*o*-methylphenyl azo

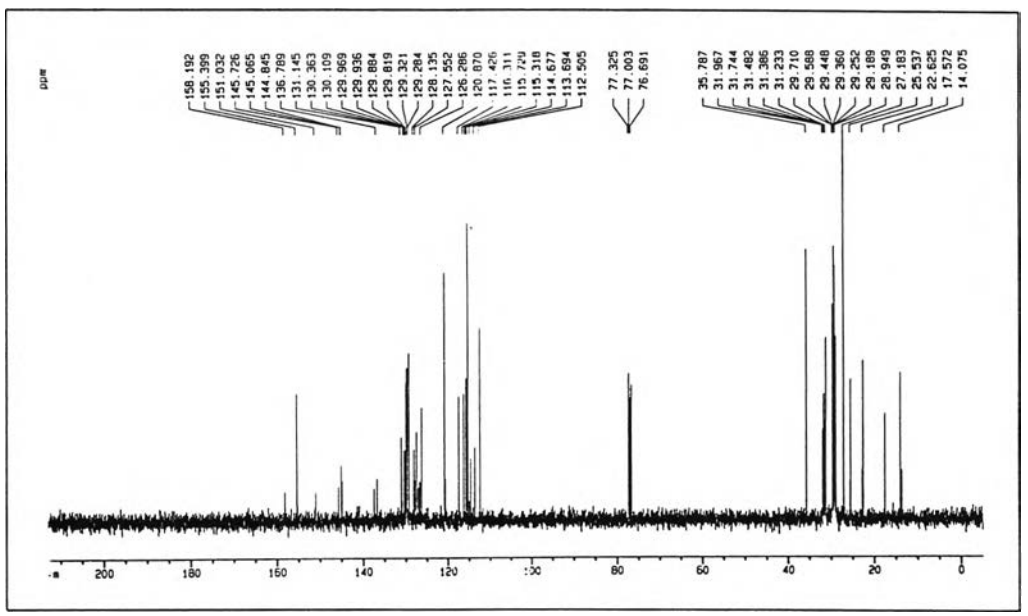

Fig. 4-49: ^{13}C-NMR spectrum of cardanol-*o*-methylphenyl azo

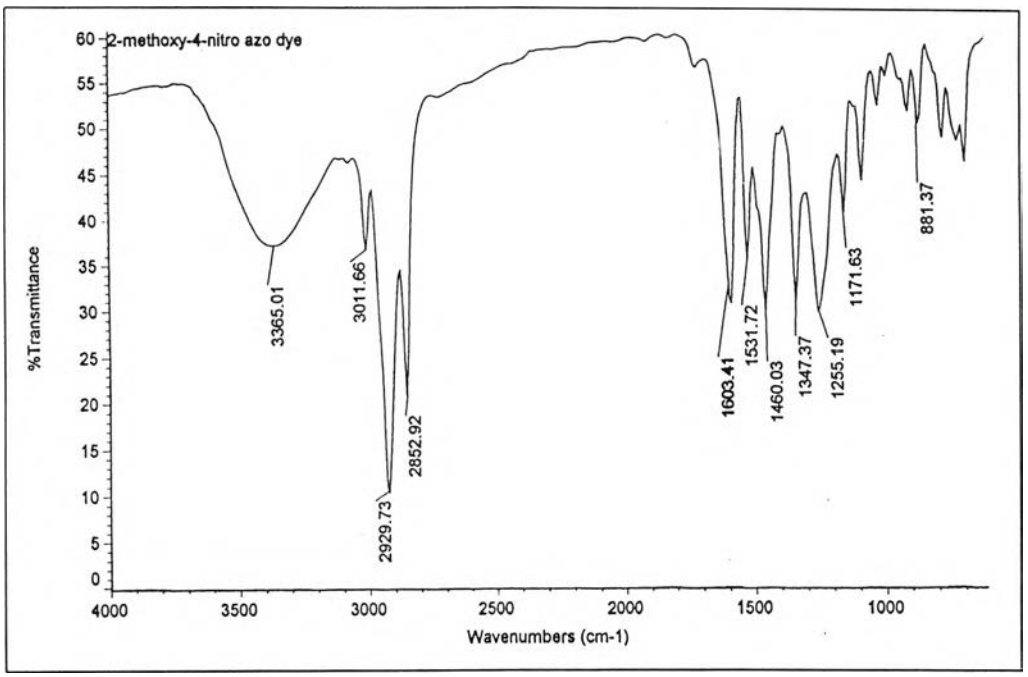

Fig. 4-50: Infrared spectrum of cardanol-2-methoxy-4-nitrophenyl azo

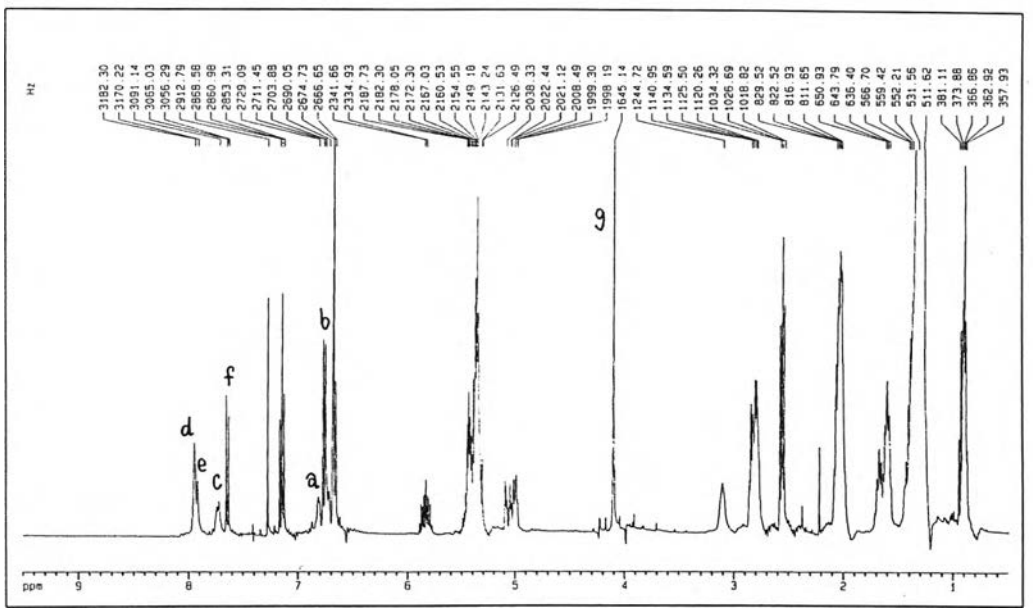

Fig. 4-51: ^{1}H-NMR spectrum of cardanol-2-methoxy-4-nitrophenyl azo

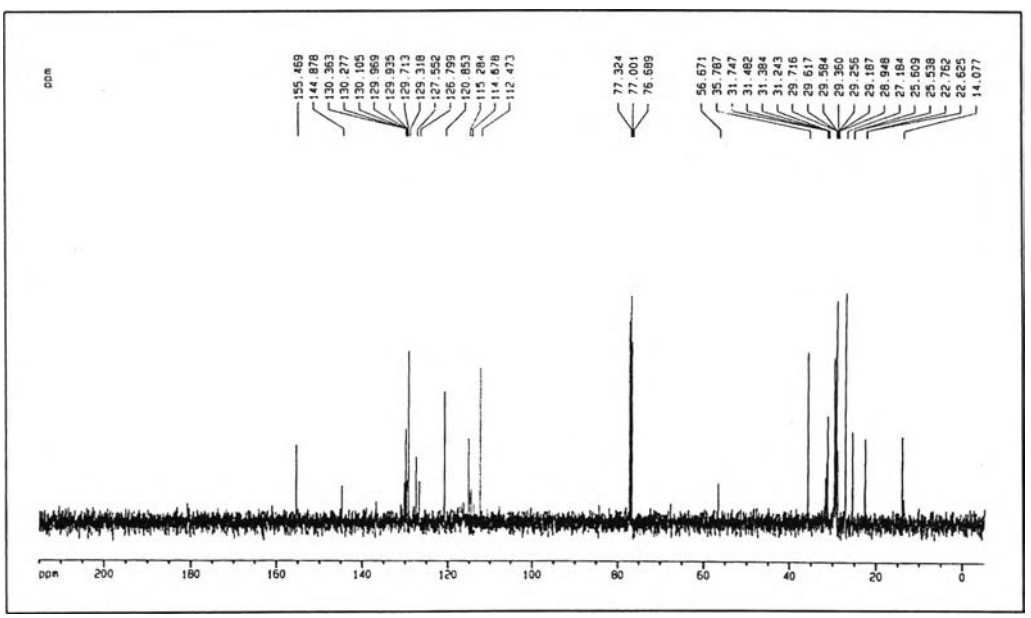

Fig. 4-52: ^{13}C-NMR spectrum of cardanol-2-methoxy-4-nitrophenyl azo

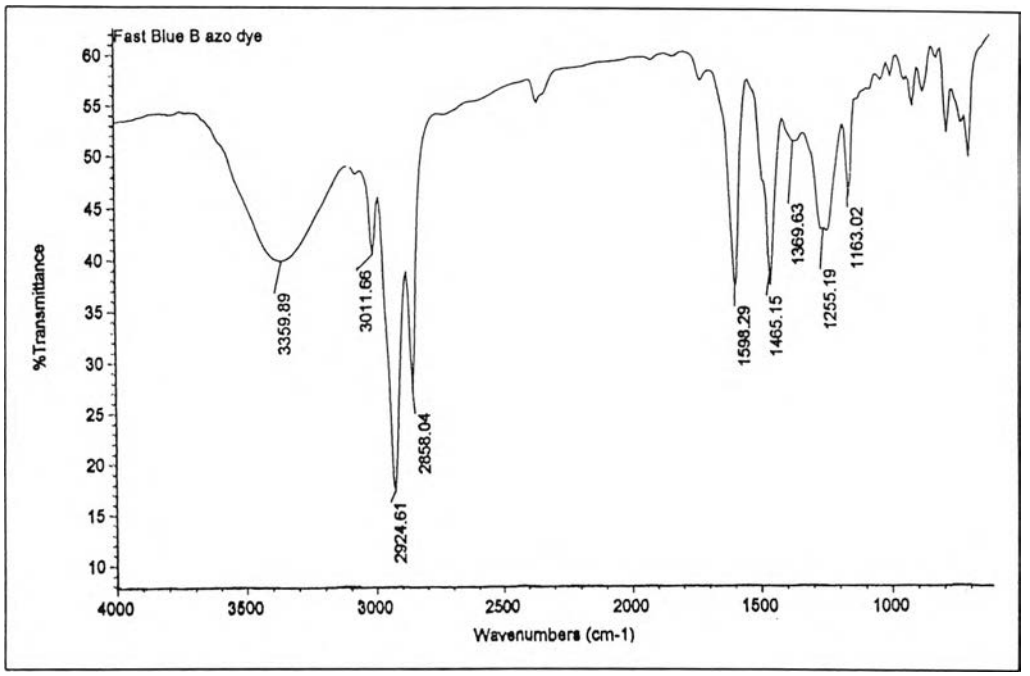

Fig. 4-53: Infrared spectrum of cardanol-Fast Blue B azo

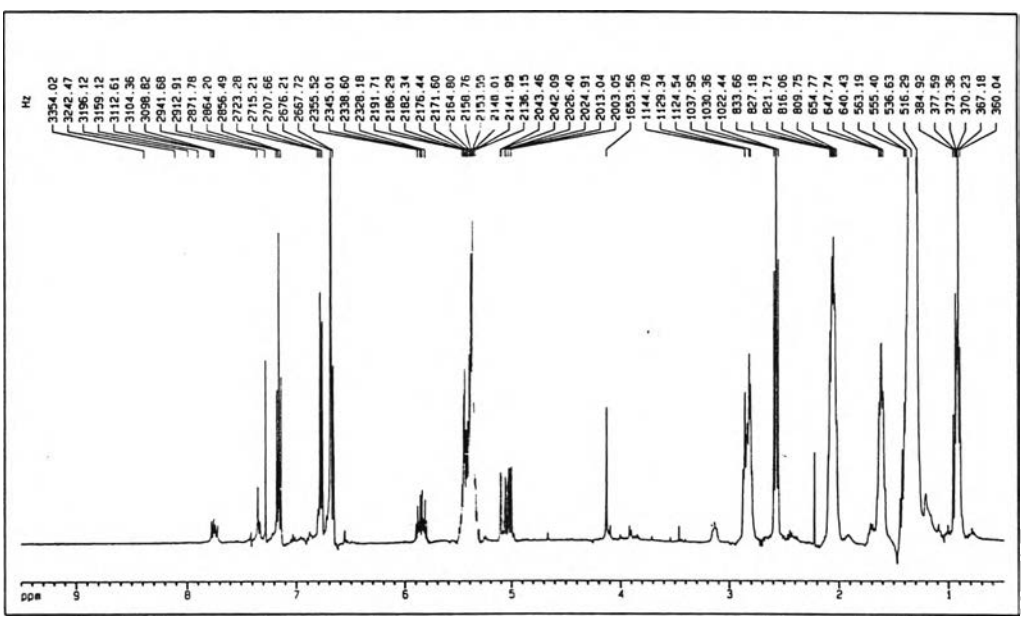

Fig. 4-54: ^{13}C-NMR spectrum of cardanol-Fast Blue B azo

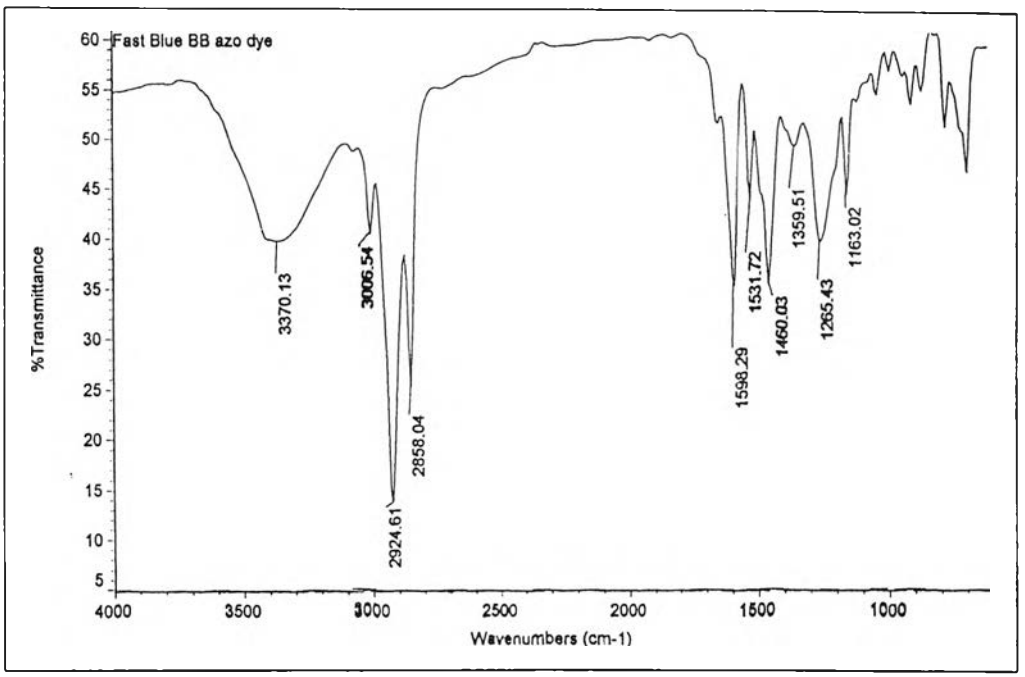

Fig. 4-55: Infrared spectrum of cardanol-Fast Blue BB azo

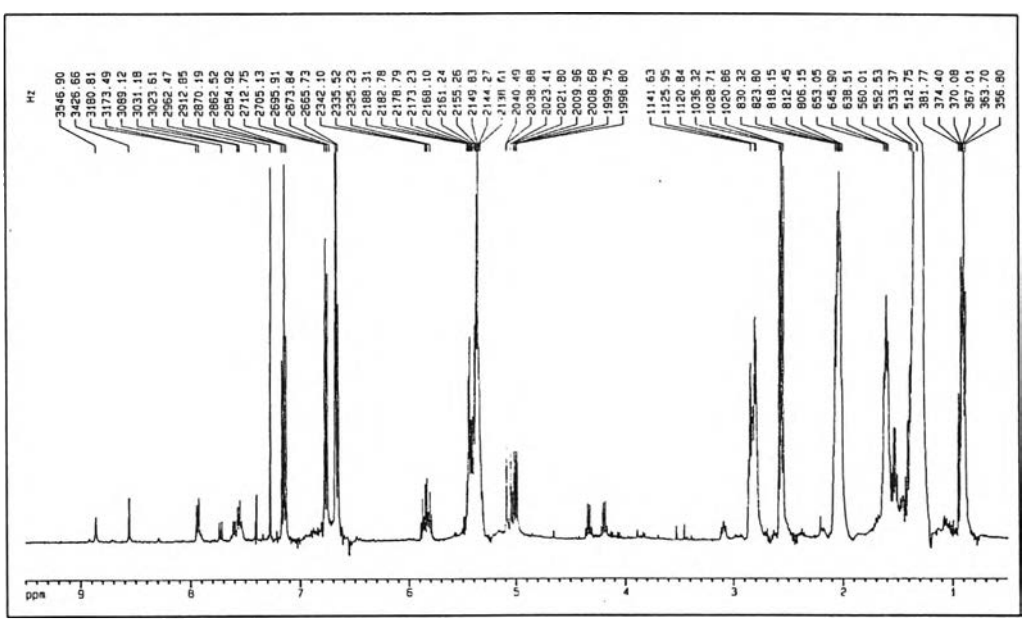

Fig. 4-56: ^{1}H-NMR spectrum of cardanol-Fast Blue BB azo

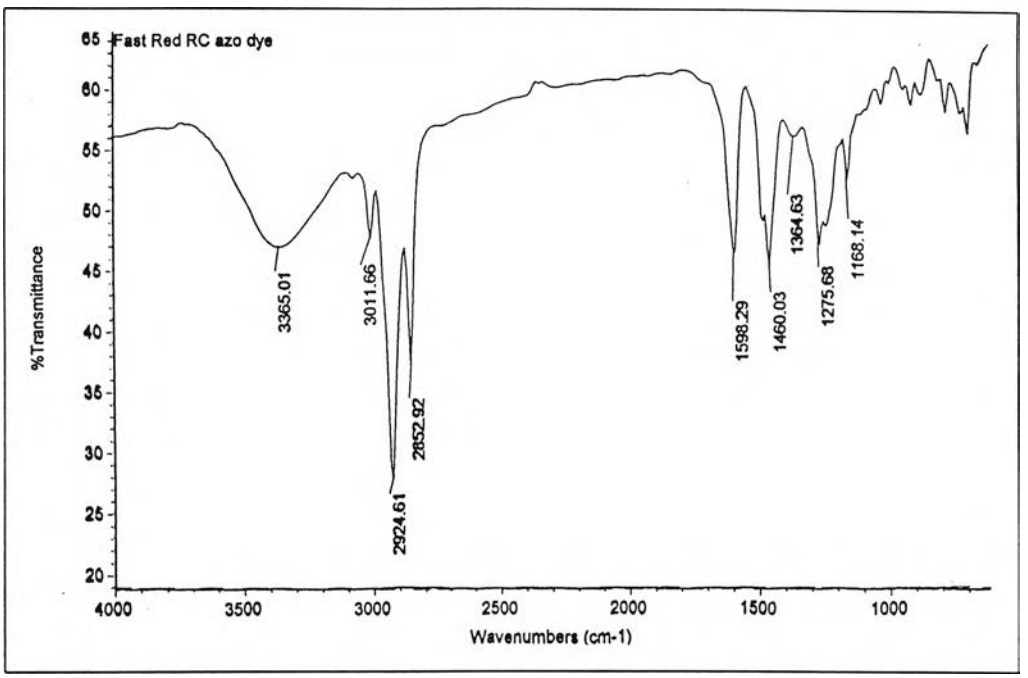

Fig. 4-57: Infrared spectrum of cardanol-Fast Red RC azo

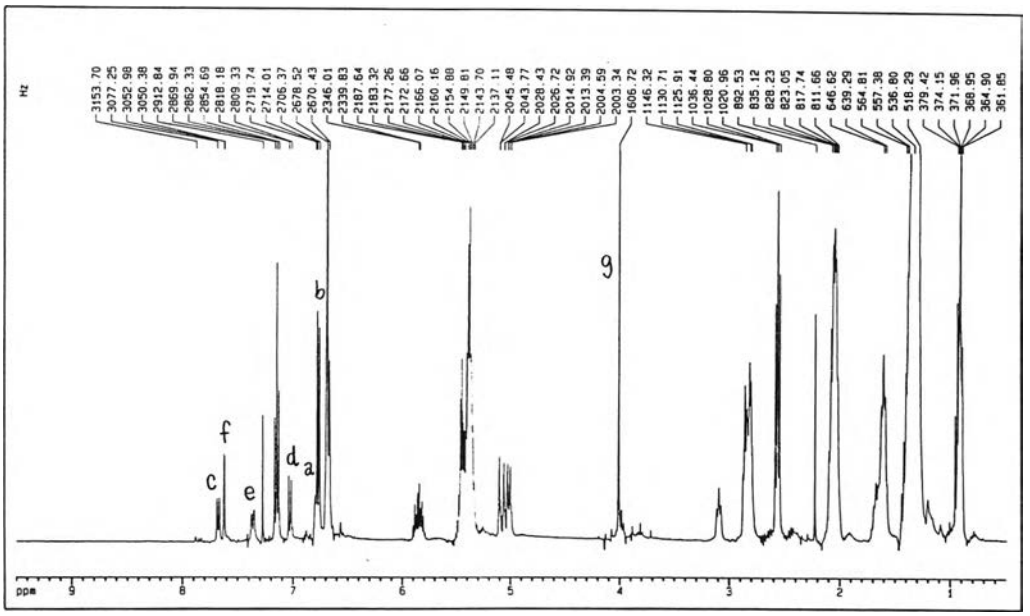

Fig. 4-58: ^{1}H-NMR spectrum of cardanol-Fast Red RC azo

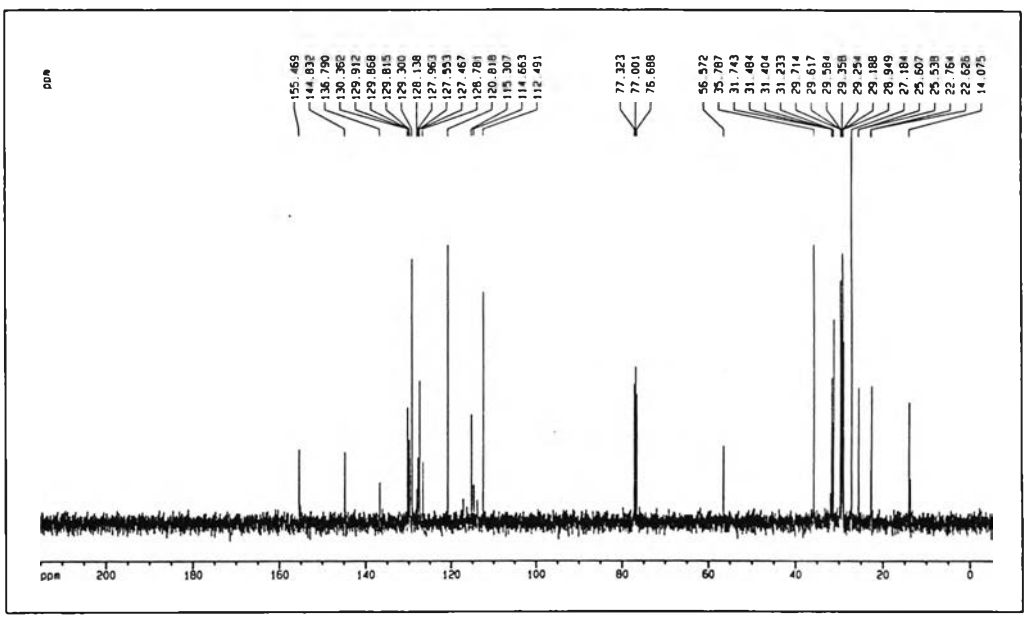

Fig. 4-59: ^{13}C-NMR spectrum of cardanol-Fast Red RC azo

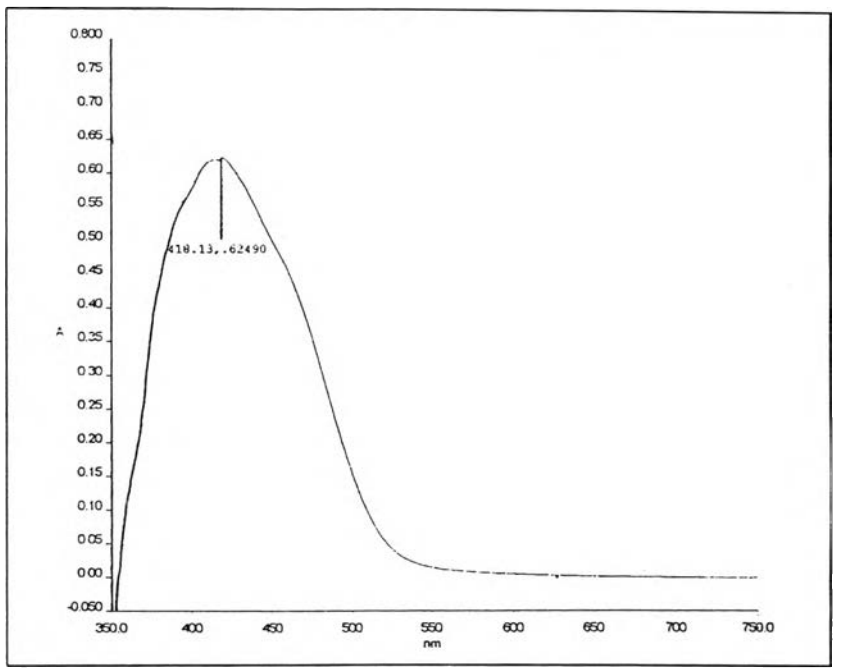

Fig. 4-72: Maximum wavelength of cardanol-phenyl azo in gasoline

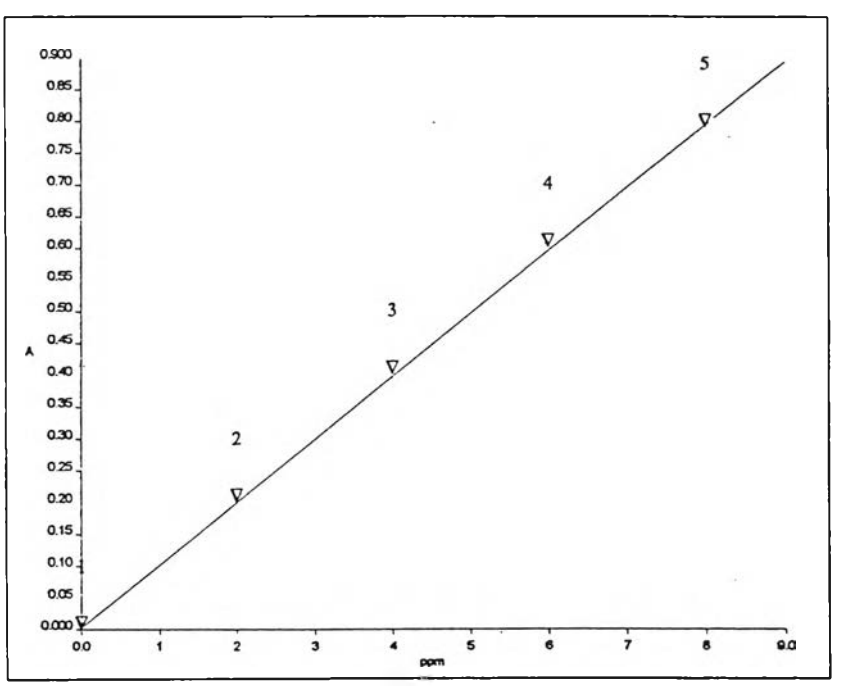

Fig. 4-73: Calibration curve of cardanol-phenyl azo in gasoline

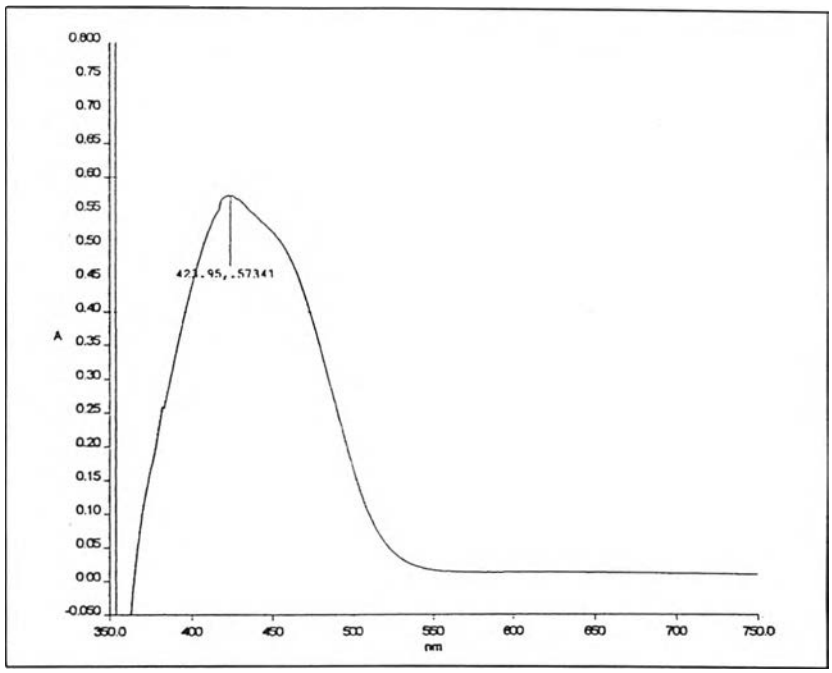

Fig. 4-74: Maximum wavelength of cardanol-phenyl azo in diesel fuel

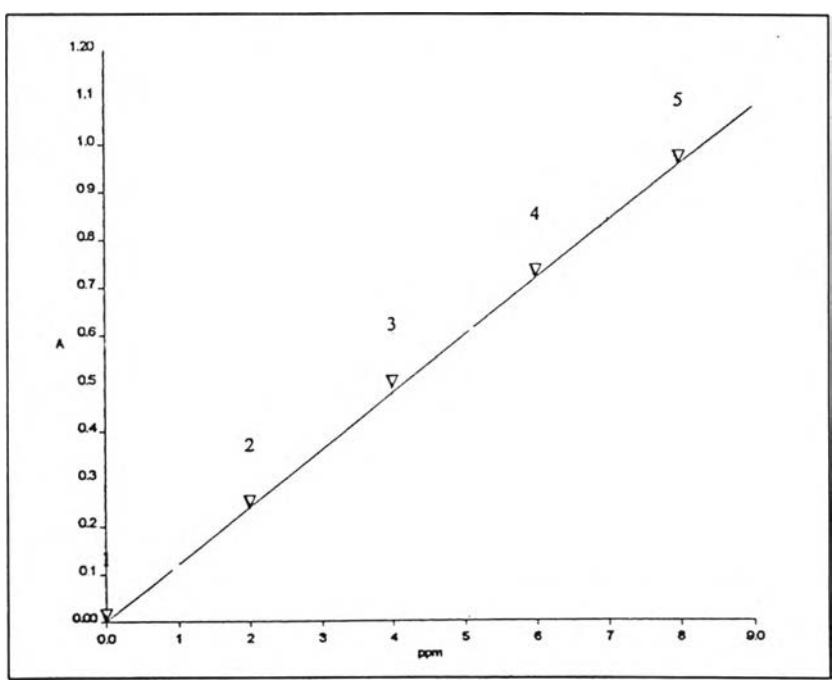

Fig. 4-75: Calibration curve of cardanol-phenyl azo in diesel fuel

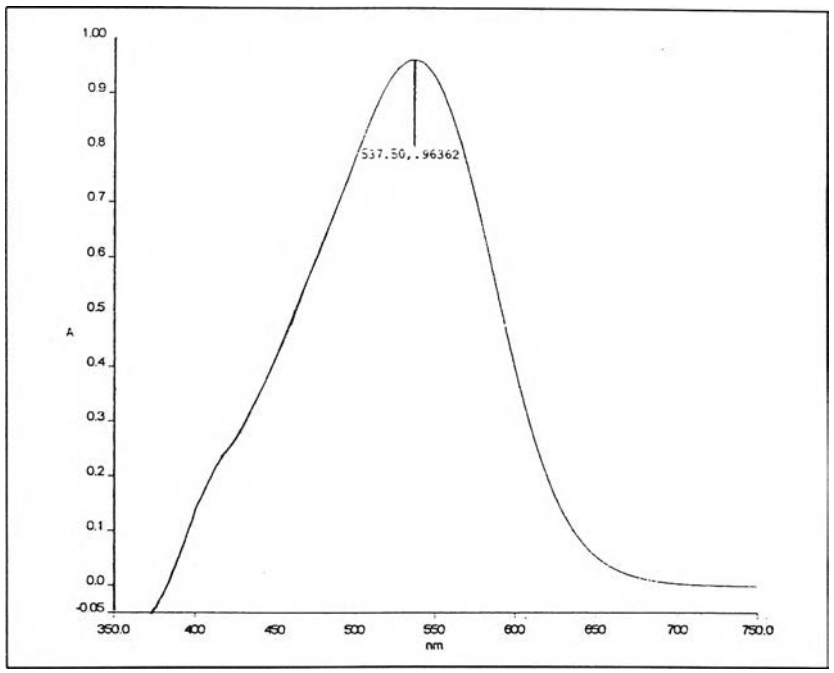

Fig. 4-76: Maximum wavelength of cardanol-*p*-nitrophenyl azo in gasoline

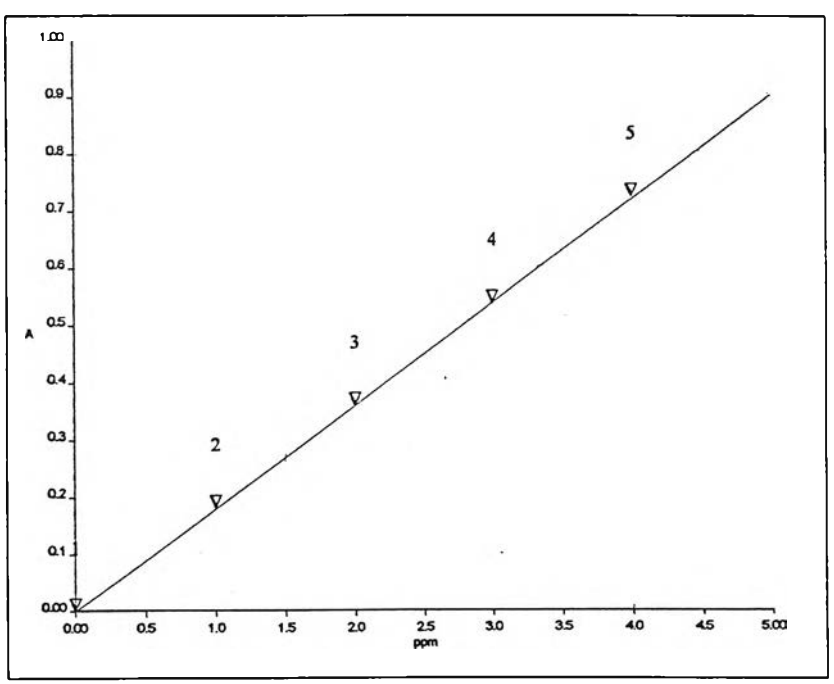

Fig. 4-77: Calibration curve of cardanol-*p*-nitrophenyl azo in gasoline

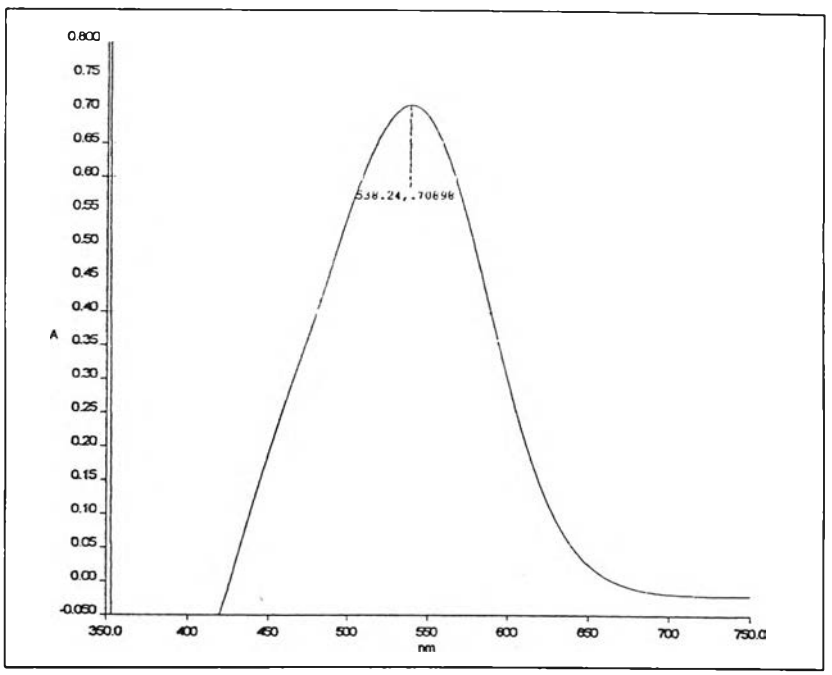

Fig. 4-78: Maximum wavelength of cardanol-*p*-nitrophenyl azo in diesel fuel

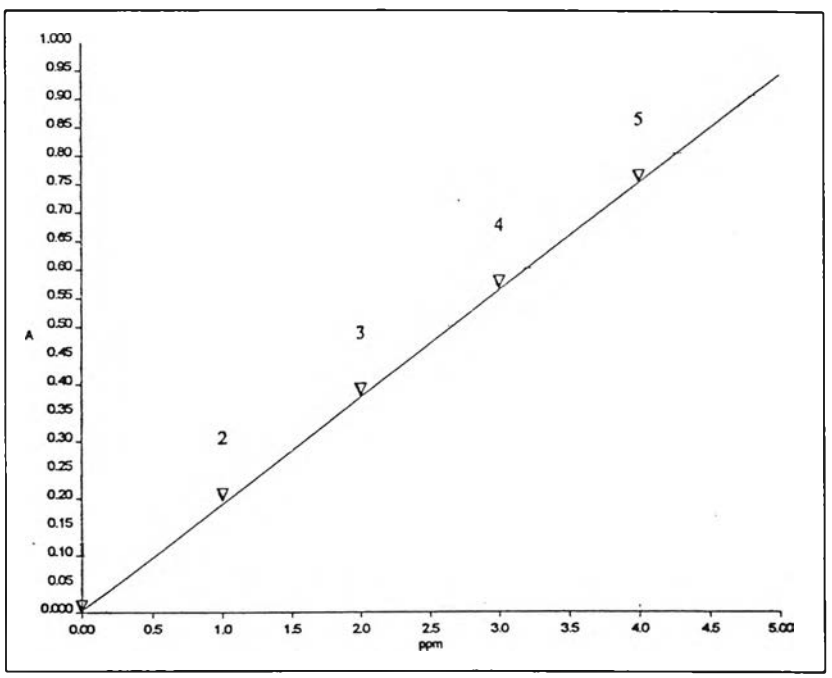

Fig. 4-79: Calibration curve of cardanol-*p*-nitrophenyl azo in diesel fuel

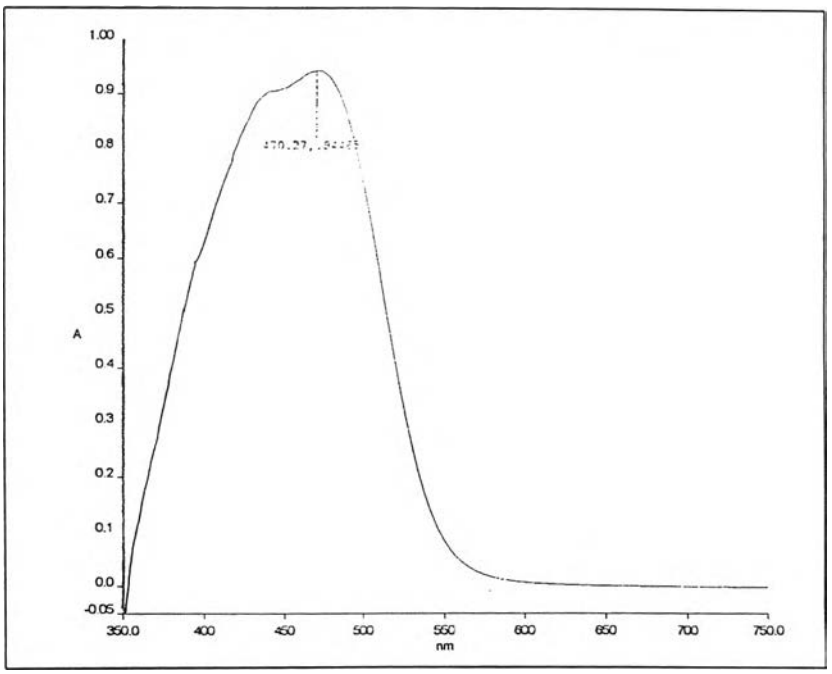

Fig. 4-80: Maximum wavelength of cardanol-*m*-nitrophenyl azo in gasoline

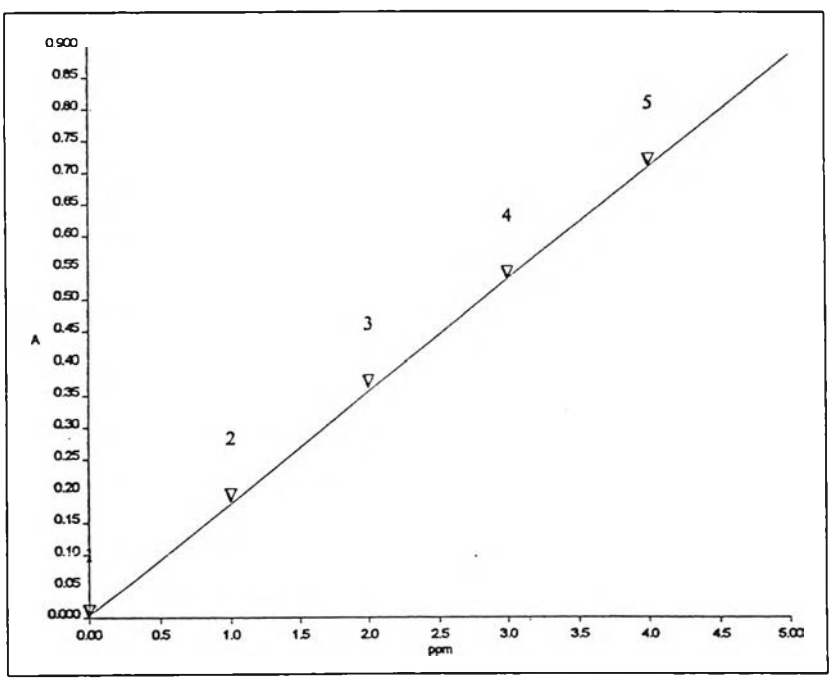

Fig. 4-81: Calibration curve of cardanol-*m*-nitrophenyl azo in gasoline

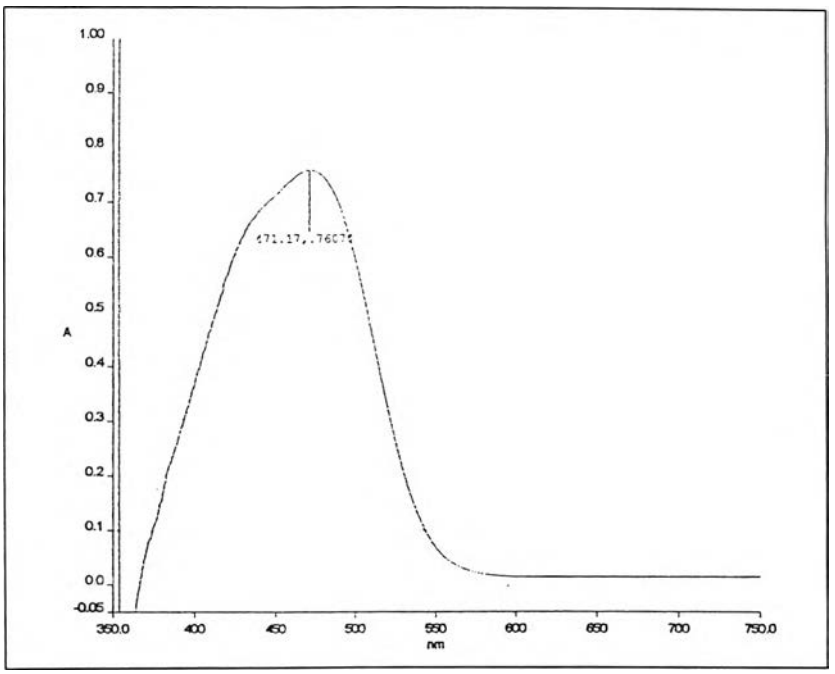

Fig. 4-82: Maximum wavelength of cardanol-*m*-nitrophenyl azo in diesel fuel

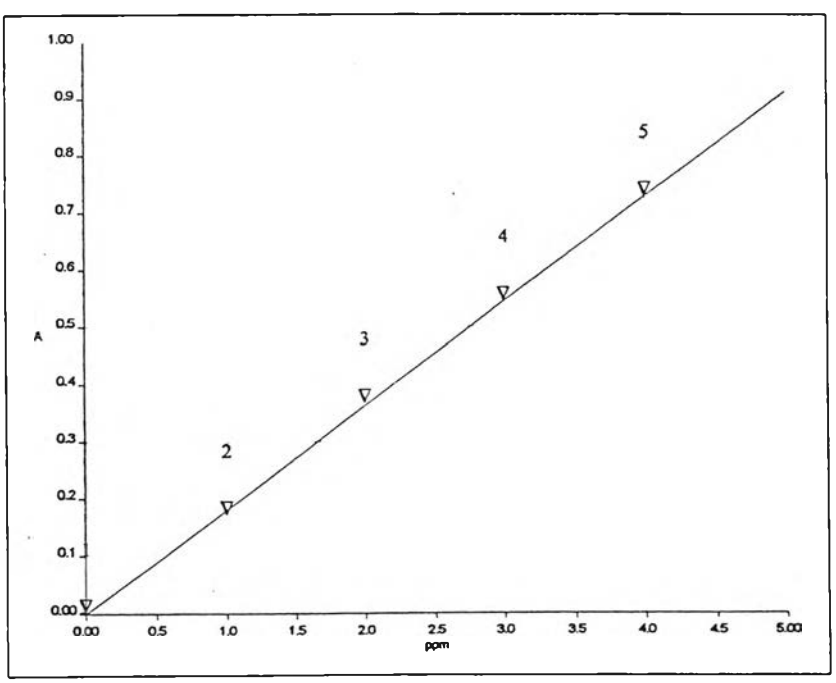

Fig. 4-83: Calibration curve of cardanol-*m*-nitrophenyl azo in diesel fuel

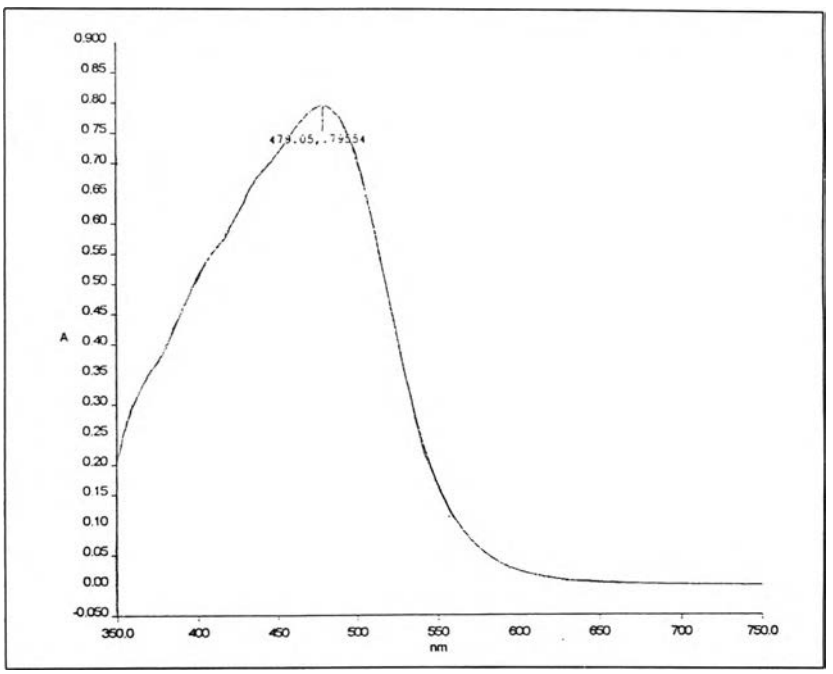

Fig. 4-84: Maximum wavelength of cardanol-*o*-nitrophenyl azo in gasoline

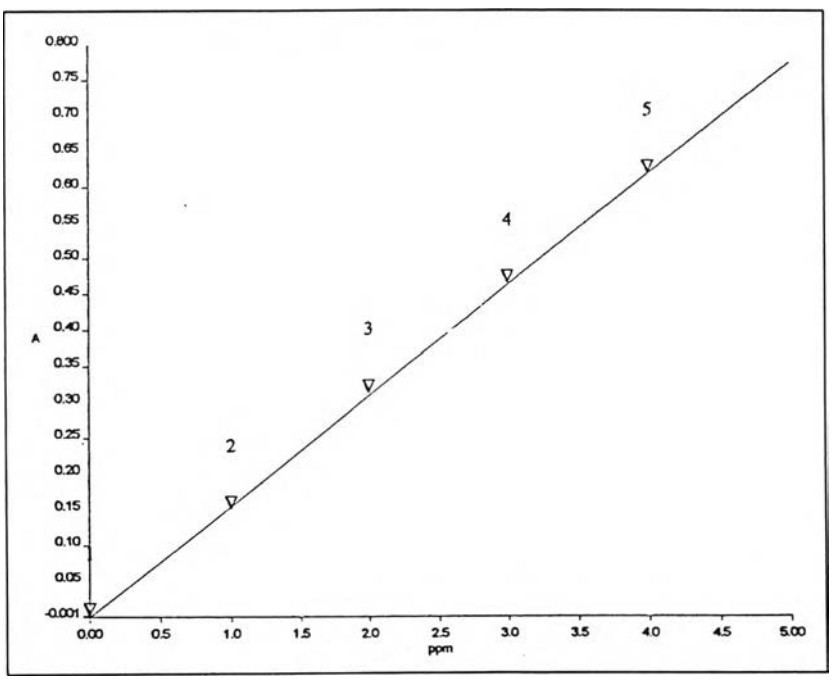

Fig. 4-85: Calibration curve of cardanol-*o*-nitrophenyl azo in gasoline

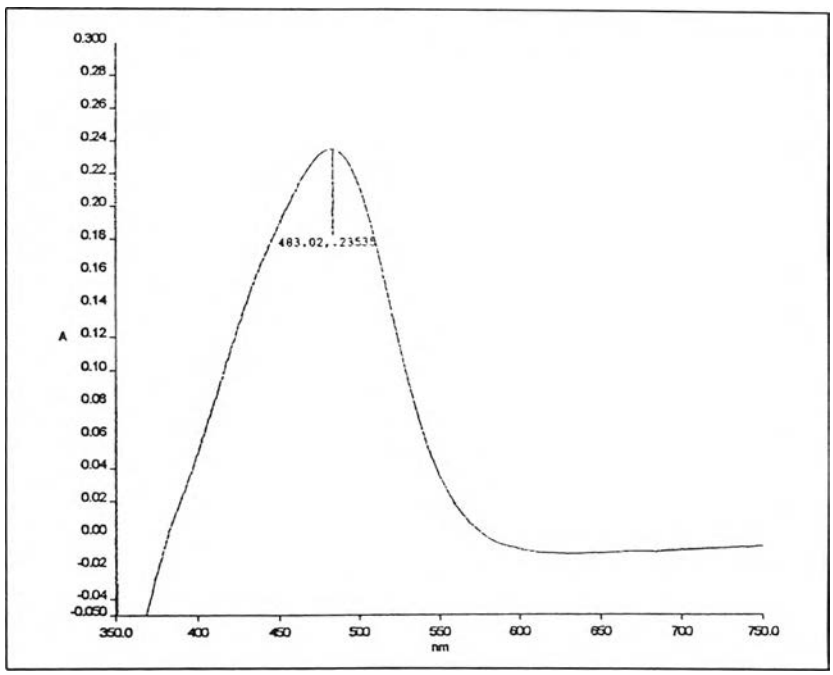

Fig. 4-86: Maximum wavelength of cardanol-*o*-nitrophenyl azo in diesel fuel

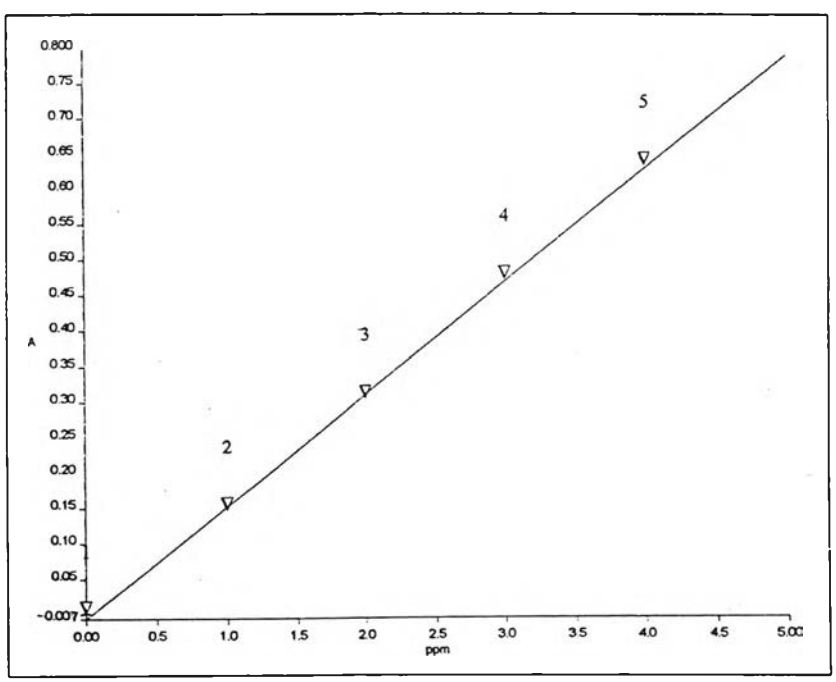

Fig. 4-87: Calibration curve of cardanol-*o*-nitrophenyl azo in diesel fuel

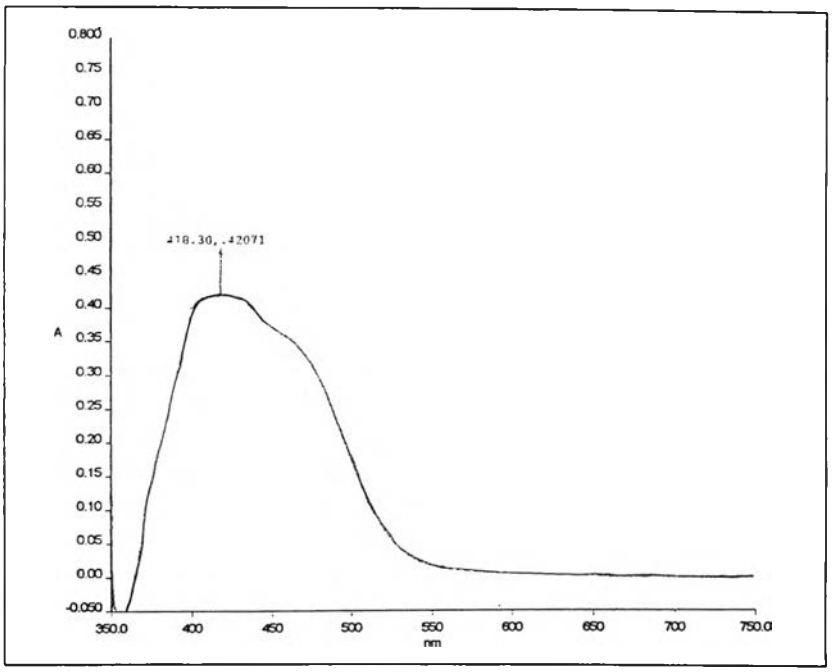

Fig. 4-88: Maximum wavelength of cardanol-*p*-chlorophenyl azo in gasoline

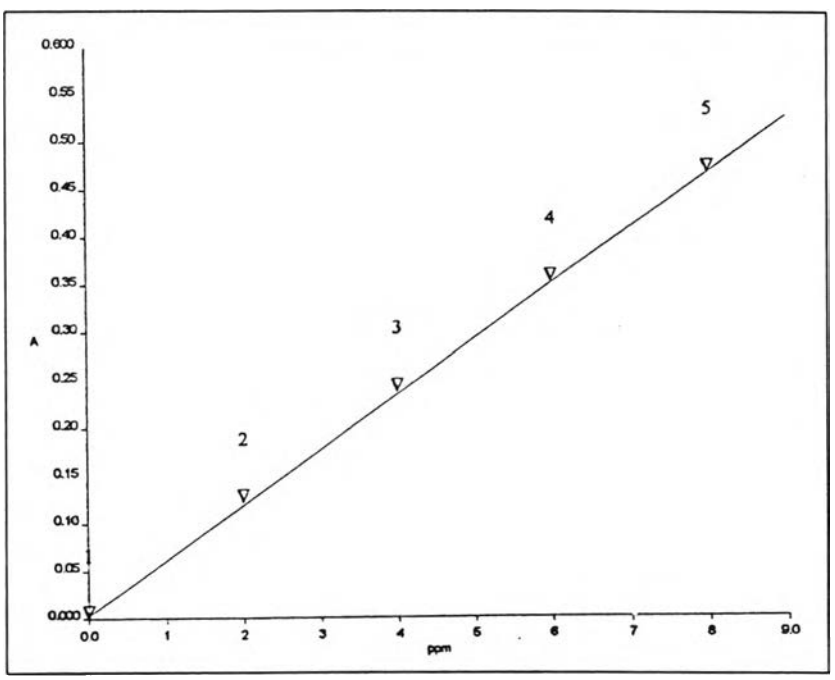

Fig. 4-89: Calibration curve of cardanol-*p*-chlorophenyl azo in gasoline

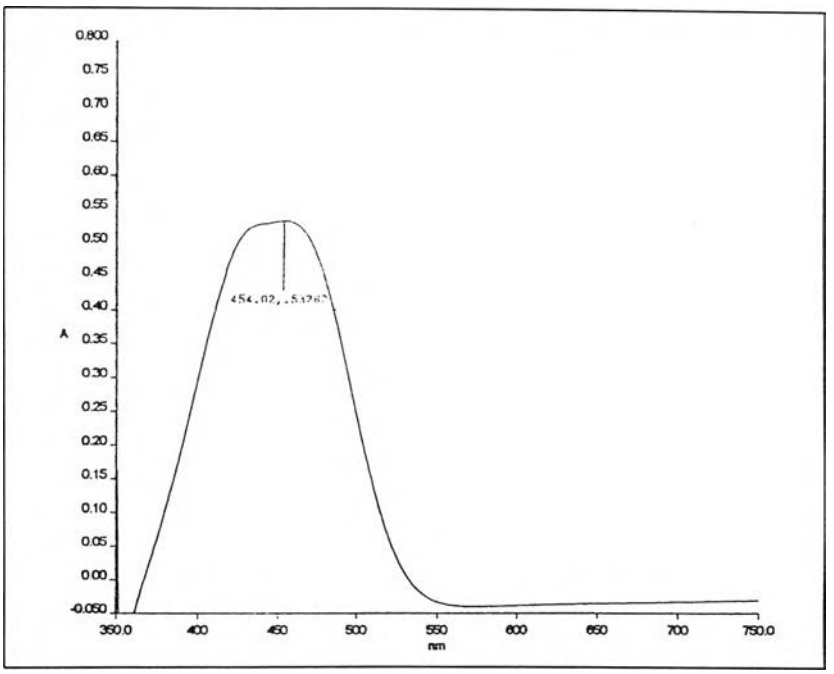

Fig. 4-90: Maximum wavelength of cardanol-*p*-chlorophenyl azo in diesel fuel

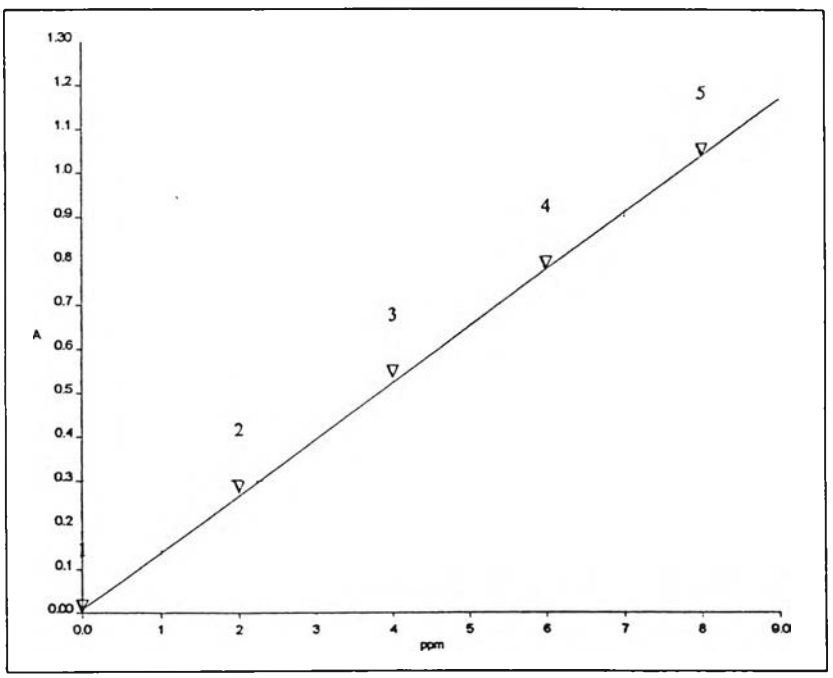

Fig. 4-91: Calibration curve of cardanol-*p*-chlorophenyl azo in diesel fuel

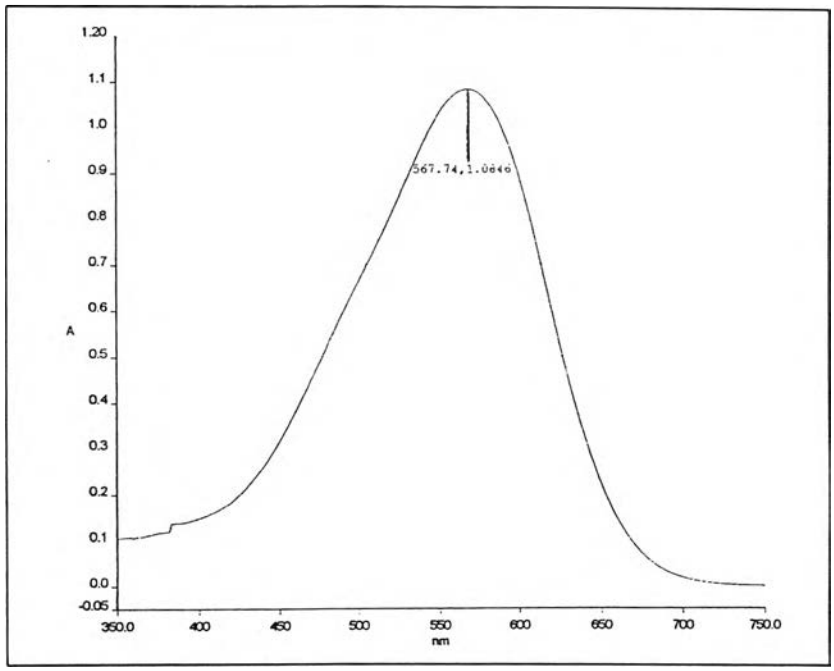

Fig. 4-92: Maximum wavelength of cardanol-2-chloro-4-nitrophenyl azo in gasoline

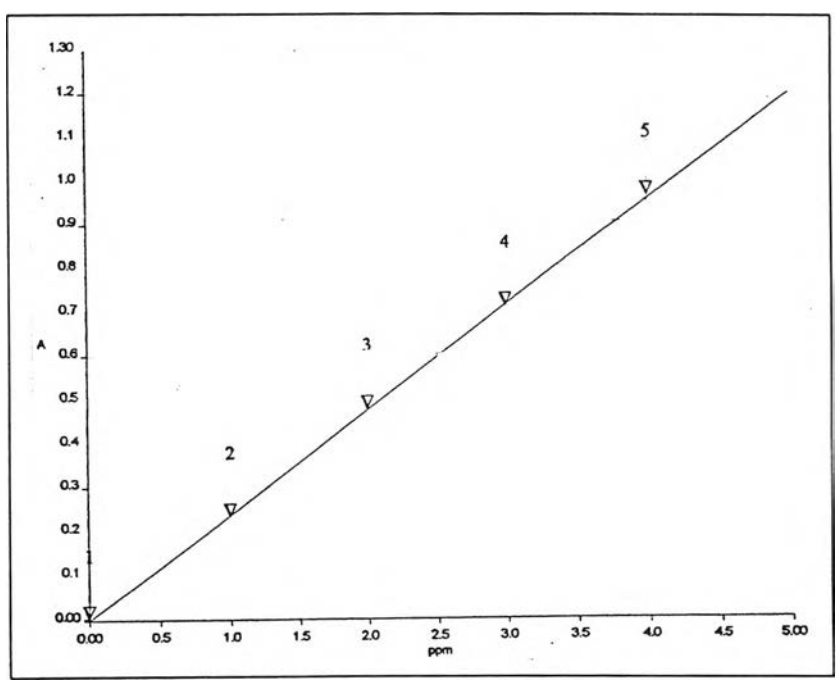

Fig. 4-93: Calibration curve of cardanol-2-chloro-4-nitrophenyl azo in gasoline

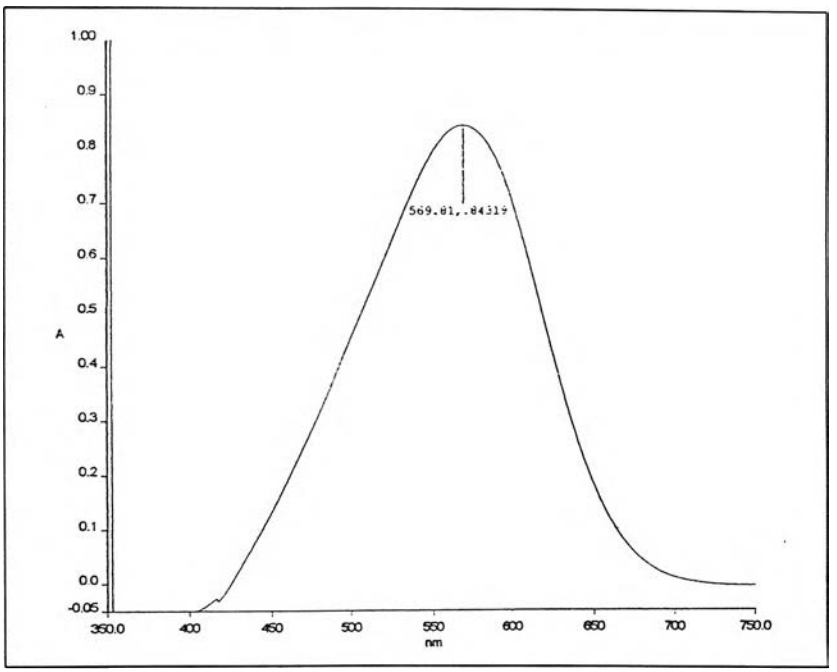

Fig. 4-94: Maximum wavelength of cardanol-2-chloro-4-nitrophenyl azo in diesel fuel

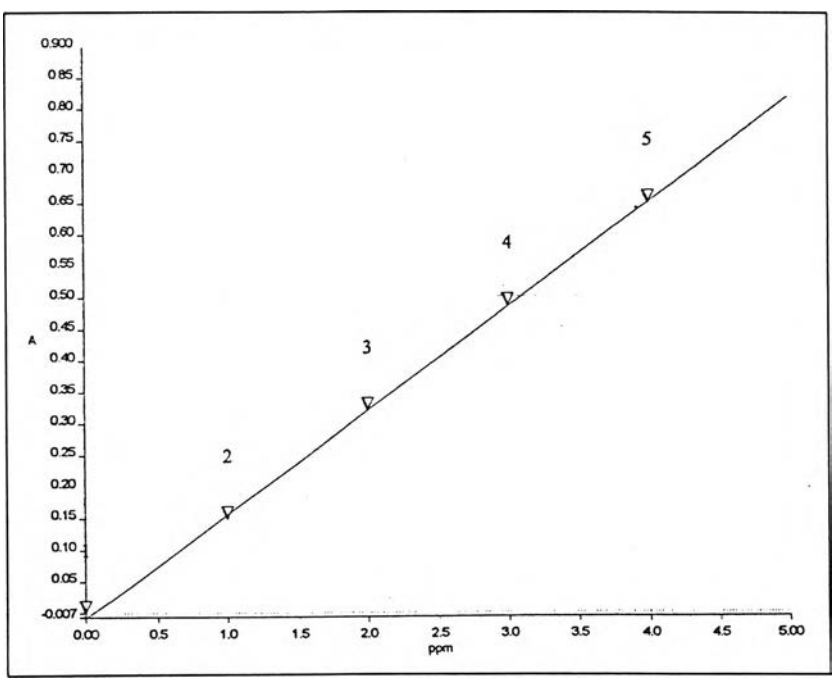

Fig. 4-95: Calibration curve of cardanol-2-chloro-4-nitrophenyl azo in diesel fuel

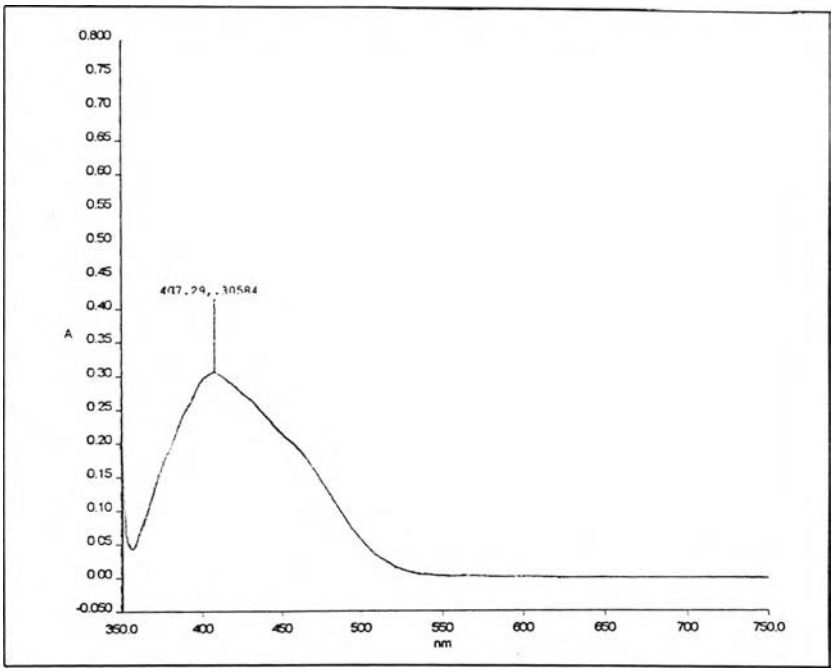

Fig. 4-96: Maximum wavelength of cardanol-*p*-methylphenyl azo in gasoline

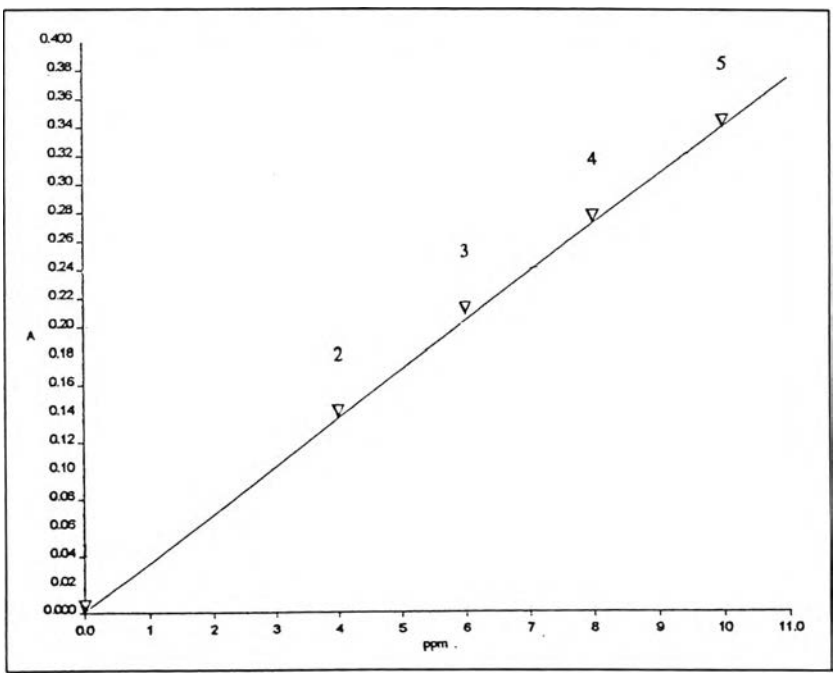

Fig. 4-97: Calibration curve of cardanol-*p*-methylphenyl azo in gasoline

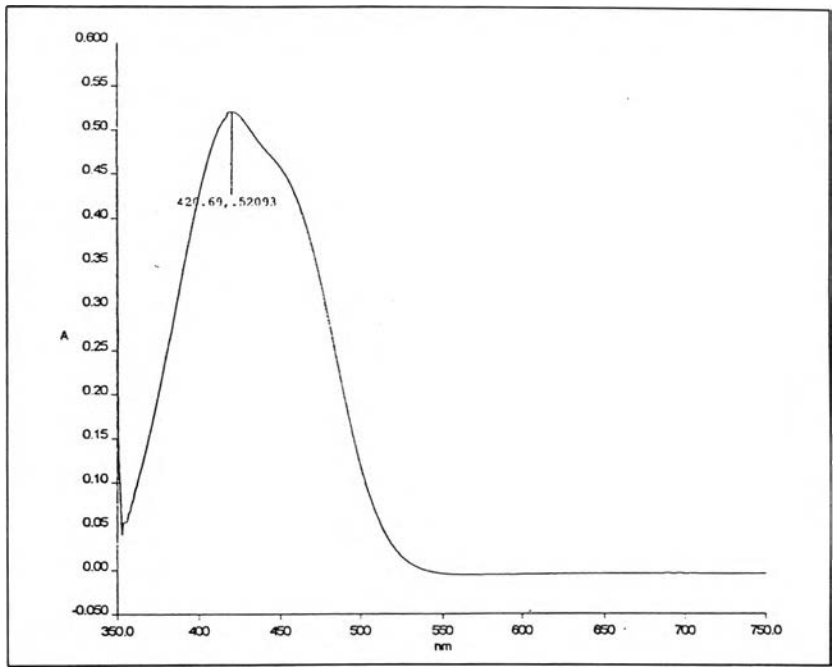

Fig. 4-98: Maximum wavelength of cardanol-*p*-methylphenyl azo in diesel fuel

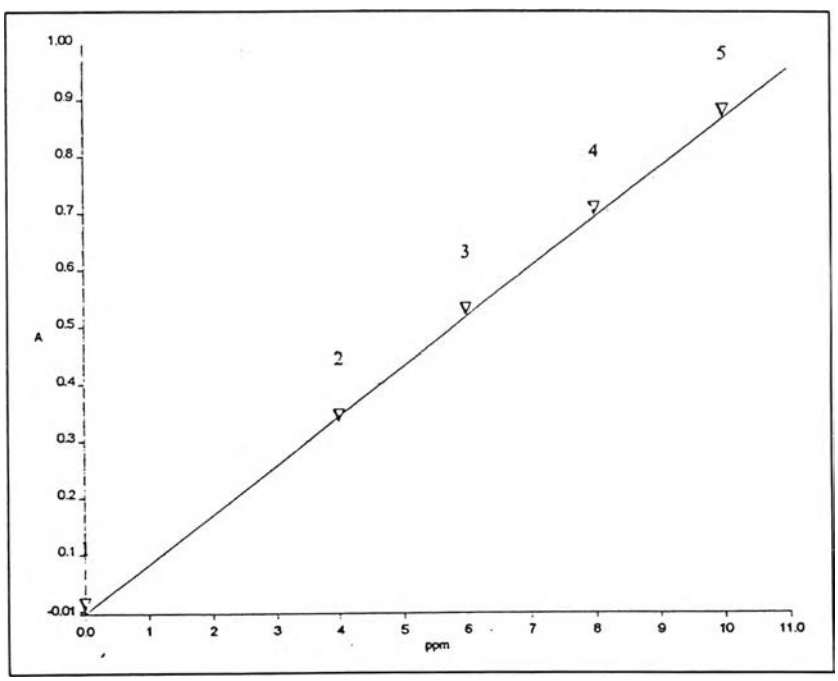

Fig. 4-99: Calibration curve of cardanol-*p*-methylphenyl azo in diesel fuel

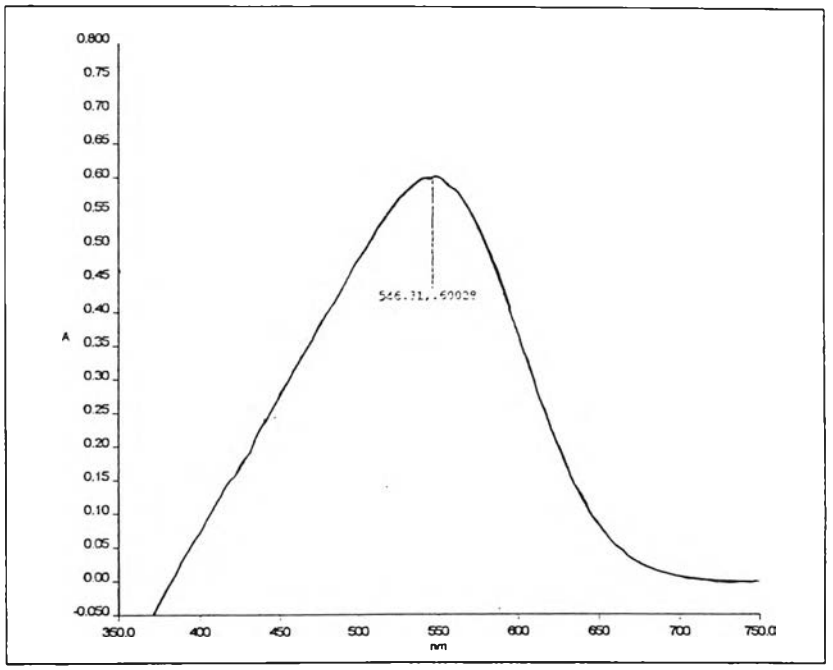

Fig. 4-100: Maximum wavelength of cardanol-2-methoxy-4-nitrophenyl azo in gasoline

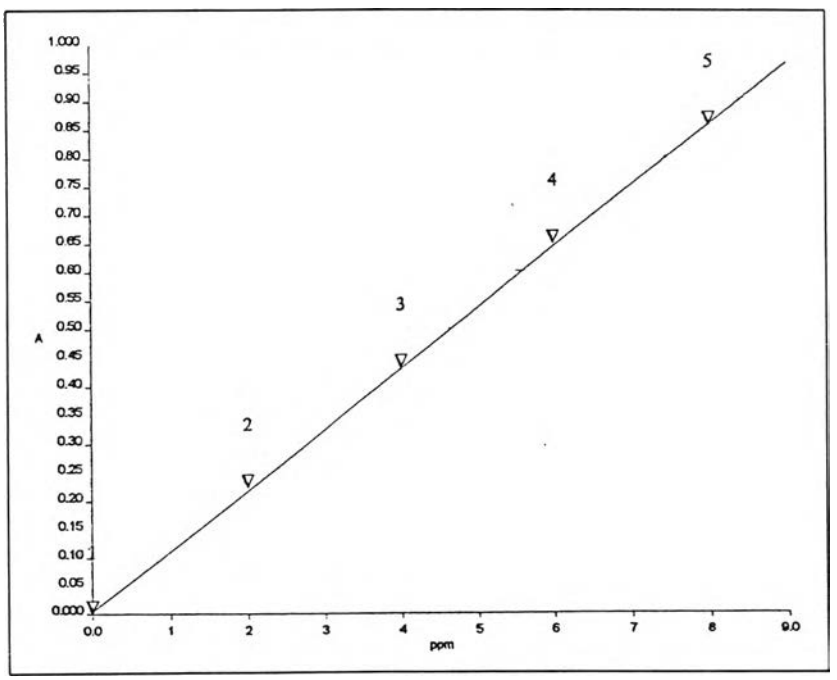

Fig. 4-101: Calibration curve of cardanol-2-methoxy-4-nitrophenyl azo in gasoline

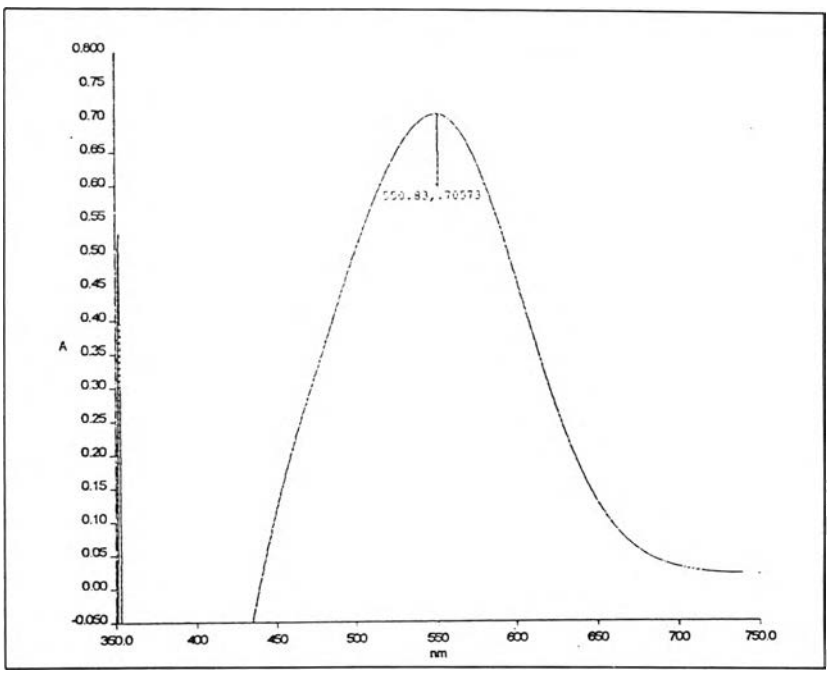

Fig. 4-102: Maximum wavelength of cardanol-2-methoxy-4-nitrophenyl azo in diesel fuel

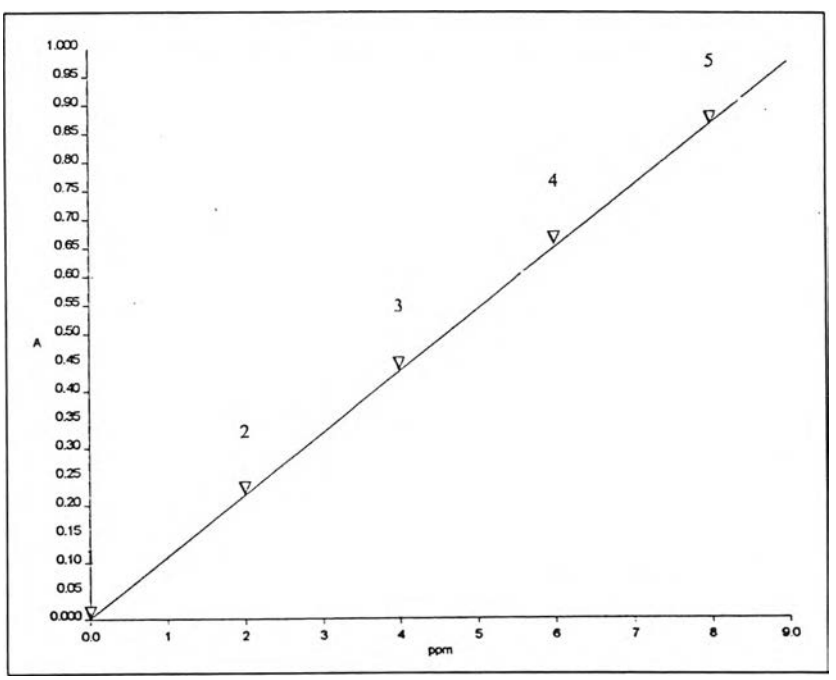

Fig. 4-103: Calibration curve of cardanol-2-methoxy-4-nitrophenyl azo in diesel fuel

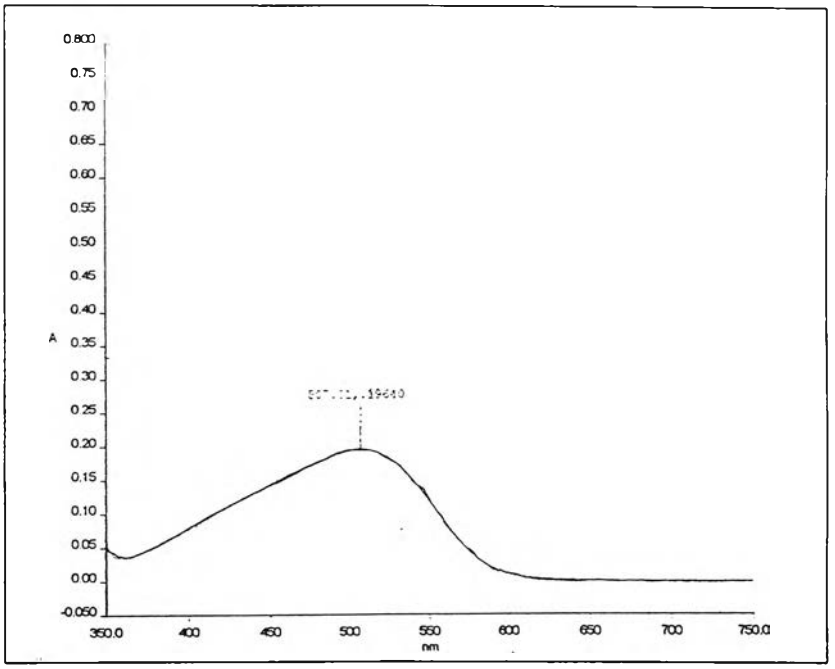

Fig. 4-104: Maximum wavelength of cardanol-Fast Blue B azo in gasoline

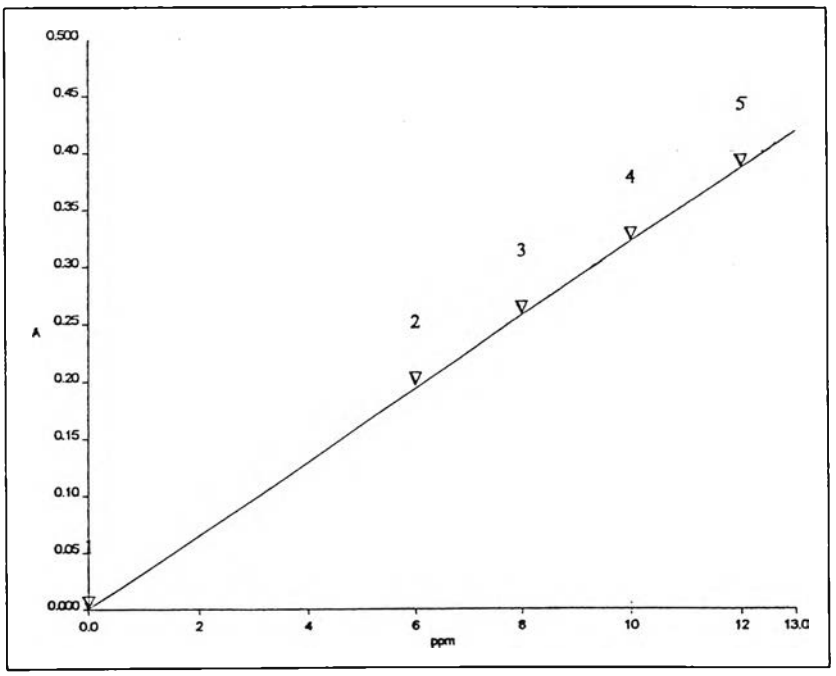

Fig. 4-105: Calibration curve of cardanol-Fast Blue B azo in gasoline

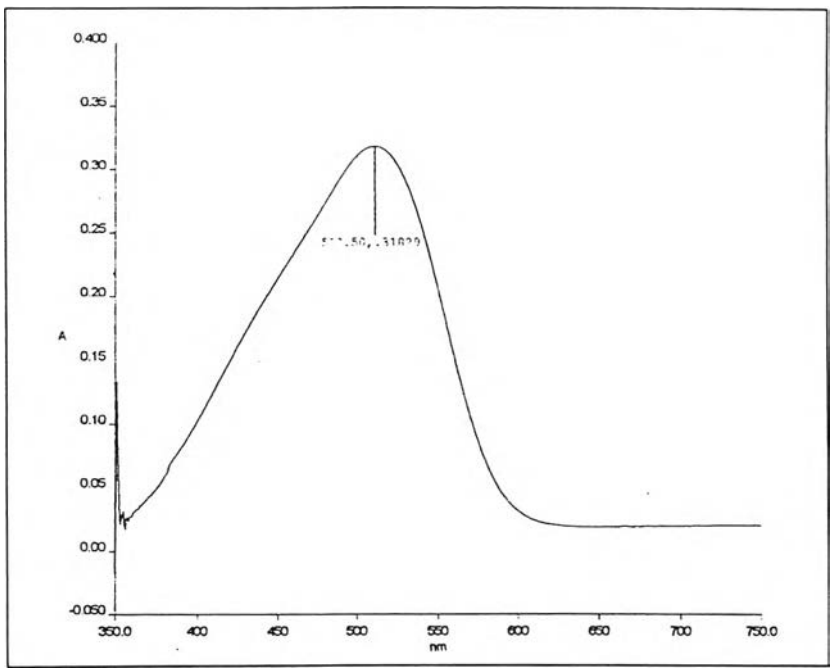

Fig. 4-106: Maximum wavelength of cardanol-Fast Blue B azo in diesel fuel

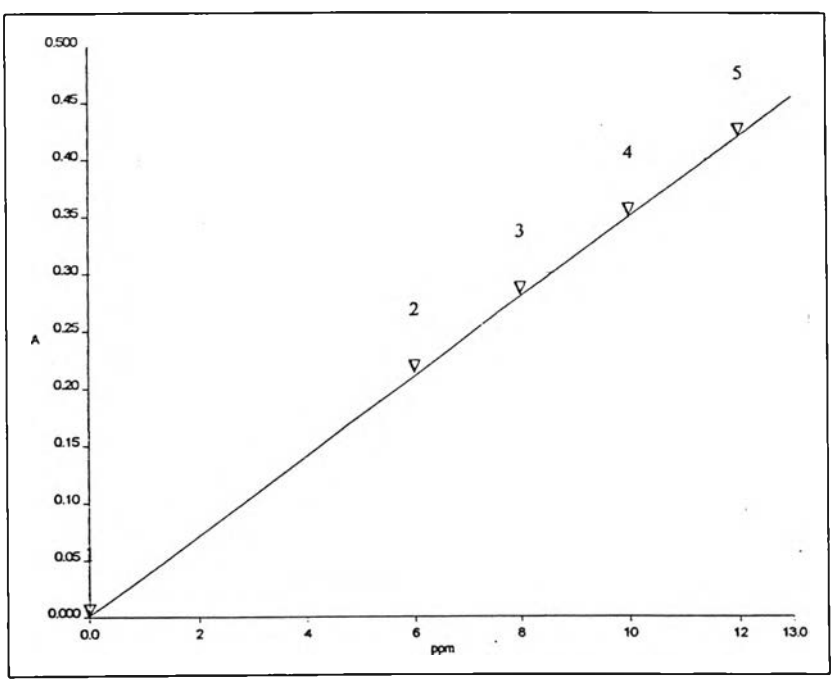

Fig. 4-107: Calibration curve of cardanol-Fast Blue B azo in diesel fuel

VITA

Miss Somsaluay Suwanprasop was born on October 3, 1977, in Bangkok, Thailand. She received her Bachelor of Science degree in Chemistry, Chulalongkorn University, in 1998. Since 1998, she has been a graduate student under the Program of Petrochemistry and Polymer Science at Chulalongkorn University, and completed her Master of Science degree in 2000.