

(72)

92122		3531
92117		4269
92130		4504
92009		3280
92024		2403
92116	# 14	4630

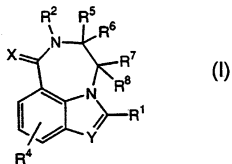
(74)

:

(54) (ADP -)

(I) (ADP -) (neurodegenerative disease) (stro
 ke), (head trauma)

[1]



(ADP -) *PARP * * *

1999 8 31

가 60/152,142

(ADP -) DNA 가 ; (stroke), (brain trauma)
 (neurotoxicity) ; , -
 (ADP -) (PARPs)
 (NAD⁺) (acceptor) ADP -
 가 -ADP - . PARP (ADP -)
 DNA , (ionizing radiation),
 (NO) DNA (histone), (topoisomerases),
 DNA RNA , DNA 가 (ligase) Ca²⁺ Mg²⁺ - (A
 DP -) DNA (DNA integrity)
 ADP - DNA DNA
 DNA , DNA - 가 , PARP
 , PARP DNA , in vitro in vivo
 , PARP

가 , PARP (ischemia) 가
 (heart stroke)
 , PARP /
 (Zhang, " PARP inhibition: a novel approach to treat ischemia/reperfusion and inflammation - rela
 ted injuries,"Emerging Drugs: The Prospect for Improved Medicines(1999), Ashley Publications Ltd.,).
 PARP 가 (Zingarelli et al., " Protect
 ion against myocardial ischemia and reperfusion injury by 3 - aminobenzamide, an inhibitor of poly(ADP - r
 ibose) synthetase,"Cardiovascular Research(1997), 36: 205 - 215).

, PARP
 (brain ischemia) , (ADP -)가 , PARP가
 (Love et al., " Neuronal accumulation of poly(ADP - ribose) after brain ischaemia,"Neu
 ropathology and applied Neurobiology(1999), 25: 98 - 103). PARP 가
 (Endres et al., " Ischemic Brain Injury is Mediated by the Activation of Ply(ADP
 - Ribose)Polymerase,J. Cerebral Blood Flow Metab.(1997), 17: 1143 - 1151; Zhang, " PARP Inhibition Res
 ults in Substantial Neuroprotection in Cerebral Ischemia,"Cambridge Healthtech Institute 's Conference on
 Acute Neuronal Injry: New Therapeutic Opportunities, Sept. 18 - 24, 1998, Las Vegas, Nevada).

DNA PARP
 (depolarized) 가
 NO 가 NO DNA
 (Cosi et al., " Poly(ADP - ribose)_Polymerase Revisited: A New Role for an Old Enzyme: PARP Involvem
 ent in Neurodegeneration and PARP Inhibitors as Possible Neuroprotective Agents,"Ann. N.Y. Acad. Sci.(
 1997), 825: 366 - 379). , NAD⁺ 가 - PARP 가

(Parkinson's disease) , PARP
 . Mandir , PARP 가 1 - - 4
 - 1,2,3,6 - (MPTP) (Mandir et al., "
 Poly(ADP - ribose)polymerase activation mediates 1 - methyl - phenyl - 1,2,3,6 - tetrahydropyridine(MPTP) -
 induced parkinsonism,"Proc. Natl. Acad. Sci. USA(1999), 96: 5774 - 5779). MPTP

(substantia nigra) - PARP
 . , PARP
 , PARP , DNA PARP (cellular sen
 escence) (, U.S. Patent No. 5,589,
 483).

, - (insulin - dependent diabetes mellitus) ,
 PARP (Saldeen et al., " Nicotinamide - induced apoptosis in insulin prod
 ucing cells in associated with cleavage of poly(ADP - ribose)polymerase,"Mol. Cellular Endocrinol.(1998),
 139: 99 - 107). (pancreatic islet cells) (streptozocin) (alloxan)
 , PARP가 (knock - our)
 (Pieper et al., " Poly(ADP - ribose) polymerase, nitric oxide, and cell d
 eath,"Trends Pharmacolog. Sci.(1999), 20: 171 - 181; Burkart et al., " Mice lacking the poly(ADP - ribose)
 polymerase gene are resistant to pantreatic beta - cell destruction and diabetes development induced by s
 treptozocin,"Nature Medicine(1999), 5: 314 - 319). PARP (scavenger)
 , (spontaneous) 가 , (non - obese)
 (Pieper et al.,ibid.). , PARP -

, PARP (Szabo et al., " Protective effect of a
 n inhibitor of poly(ADP - ribose)synthetase in collagen - induced arthritis,"Portland Press Proc.(1998), 15
 : 280 - 281; Szabo, " Role of Poly(ADP - ribose)Synthetase in Inflammation,"Eur. J. Biochem.(1998), 320(
 1): 1 - 19; Szabo et al., " Protection Against Peroxynitrite - induced Fibroblast Injury and Arthritis Develo
 pment by Inhibition of Poly(ADP - ribose) Synthetase,"Proc. Natl. Acad. Sci. USA(1998), 95(7): 3867 - 7
 2).

PARP (telomere)
 TRF - 1 (tankyrases) , PARP in vitroPARP
 (catalytic domain) . PARP (ADP -
) 가 , (telomer
 ase) PARP , (cell life - span) ,

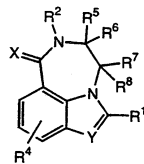
PARP, Banasik (" Specific Inhibitors of Poly(ADP - Ribose) Synthetase and Mono(ADP - Ribosyl) transferase,"J. Biol. Chem.(1992) 267: 1569 - 1575) 100가
 PARP, 가 4 - - 1,8 - , 6(5H) -
 (phenanthridone), 2 - - 6(5H) - 1,5 - . Griffin
 (U.S. Patent No. 5,756,510: " Novel Potent Inhibitor of the DNA Repair Enzyme Poly(ADP - ribose)polymerase(PARP),"Anti - Cancer Drug Design(1995), 10: 507,514), (WO97/04771) (WO98/33802) PARP -
 . Suto (" Dihydroisoquinolines: The Design and Synthesis of a New Series of Potent Inhibitors of Poly(ADP - ribose) Polymerase,"Anti - Cancer Drug Design(1991), 7: 107 - 117). Griffin PARP (" Resistance - Modifying Agents. 5. Synthesis and Biological Properties of Quinazoline Inhibitors of the DNA Repair Enzyme Poly(ADP - ribose) Polymerase(PARP),"J. Med. Chem.(1998) 41: 5247 - 5256). WO99/11622 , WO99/11623 , WO99/11624 , WO99/11628 , WO99/11644 , WO99/11645 WO99/11649 PARP - PARP W
 ebber et al. 1999 1 11 가 60/115,431 (.).

PARP
 (pharmacokinetic) 가 .

PARP - .

PARP :

[1]



(I)

, X O S ;

Y N CR³,

R³ H;

;

;

" " (가 , - 가), ; , ; - .

" " ; , ; , - .

" " 3 18 (가) - 1가 , (adamantyl), (phenanthrenyl)

" " 1 5 , 3 18 - 1가 , (piperaziny), (pyrrolidiny), (morpholin), (tetrahydrofury), (piperidiny), (thiomorpholin), (aziridiny)

" " 4 18 () (anthraceny)

" " 1 5 , 4 18 1가 , (pyrroly), (thienyl), (oxazolyl), (pyrazolyl), (thiazolyl), (furyl), (pyridiny), (pyraziny), (thiazolyl), (indoly), (quinolinyl), (quinoxanlinyl)

" " " " - NH₂ , " " 0, 1 2 가 - NH₂ 가 , - NHR_a , R_a R_b , R_a R_b

" " " (group)가 , 가 (,) , (,) .

" " " " (F, Cl, I Br), (oxo), , , (mercapto), , ,

(1, 2, 3),

(perfluoro) - (moieties)
 ; -OH, NH₂ 가 ; -OH; -NO₂; -CN; CO₂H; O- 가
 ; ; -O- ; - 가 ; -OCHF₂; -CF₃; -OCF₃; -CO₂R_a, -CONR^aR^b, -OCH₂CONR^aR^b, -N
 R^aR^b, -SO₂R^aR^b, R^a R^b H, 가 ; (m
 oieties) 가 , -O-(CH₂)_z-O-(, z 1, 2 3)

" " (solvolysis),

" " (, Bertol
 ini, G. et al., J. Med. Chem., 40, 2011 - 2016(1997); Shan, D. et al., J. Pharm. Sci. 86(7), 765 - 767; Bagsha
 we K., Drug Dev. Res., 34, 220 - 230(1995); Bodor, N., Advances in Drug Res., 13, 224 - 331(1984); Bundg
 aar, H., Design of Prodrugs(Elsevier Press 1985); Larsen, I.K., Design and application of Prodrugs, Drug
 Design and Development(Krogsgaard - Larsen et al., eds., Harwood Academic Publishers, 1991).

" " 가 (solvate)
 , DMSO,

" 가 " - (free - acid)
 가 (pyrosul
 fates), (bisulfates), (bisulfites), (propion
 ates), (propiolate), (suberates), (sebacates),
 - 1,4 - - 1,6 - (phthalates),
 (xylenesulfonates), (phenylacetates), (tartrates),
 - 1 - - 2 -

(male
 ic acid), (mandelic acid), (fumaric acid), (malonic acid),
 (glucuronic acid) (galacturonic acid) (pyranosidyl
 acid) ; (tartaric acid) - ;
 ; (benoic acid) (cinnamic acid) ; p -

; -
 , (1, 2, 3),
 ; ; 1, 2, 3 ;
 ; , , , , , , ,

ph) (polymor

(chiral center) 가 가
 (racemates), / (enantiomer) /
 (diastereomer) ()
 ()
), 99%(98% e.e.) 95%(90% e.e.), 90%(80% 97.5%(95% e.e.), 가

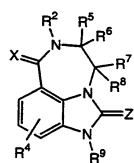
(互變異性) (tautomeric form)
 , R¹ OH SH , Y가 N , 가

R¹ , , ; R¹ ;
 C(O)R¹² (R¹² NR²¹, R²²); S(O)nR¹⁶ (R¹⁶ H , n 0, 1 ; R¹ ;
 2 (R⁴ H . R⁵, R⁶, R⁷ R⁸ . R² H 가 H

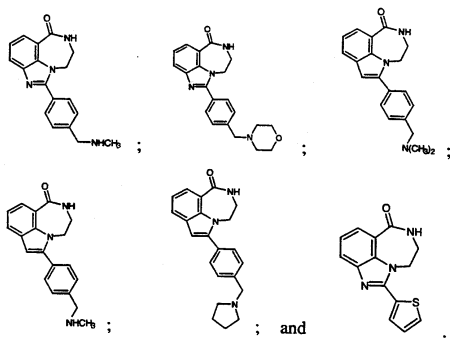
H ; R⁵, R⁶, R⁷ R⁸ , R¹ ; R² H ; R⁴
 H ; X

, R¹ OH SH , Y N .
 (tautomers) (, Z O S , R⁹ H
 :

[2]



(II)



2, 6, 8, 14, 34, 37, 58, 59, 75, 82, 98, 99, 119, 129, 130, 132, 134, 137, 141, 142, 148, 149, 170, 171, 177, 184, 186, 197, 203, 207, 210, 211, 212, 223, 233, 245 246

:

(" ") PARP , PARP 가 , , PARP

" " " "

, PARP

, (a)

b) 가 가 ; / , (c) ; (

PARP

(interventions)

mozolimide)) / (, (topotecan), (irinotecan), (te PARP - (가 , ,

tiation assay) , 1 PF 50 (cytotoxicity poten

PARP -

, PARP -

(fibroblast cells)

가 ,

PARP - (cardiovascular disease) 가 (myocardial ischemia) (reperfusion injury)

PARP in vivo in vitro

PARP 가

P-) (PAR

(filling) 가

가 (terra alba), (talc), (acacia), (wax) 가 (prolonged - release material) (syrup), (elixir), 가 () ,

PARP - (가 , ,) , PARP 가 ; ; ; " " , 가 , PARP 가

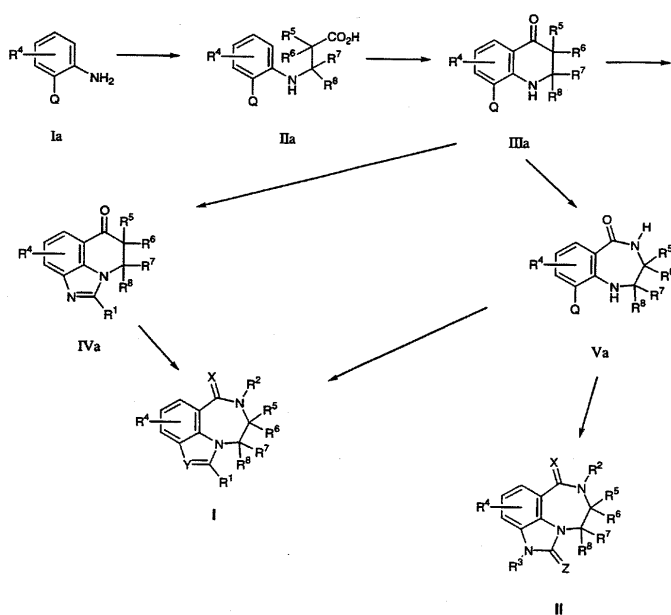
가

PARP -

0.001 1000mg/kg

PARP -

A



(ortho) - (Ia) N - (IIa) (IIIa) Q가

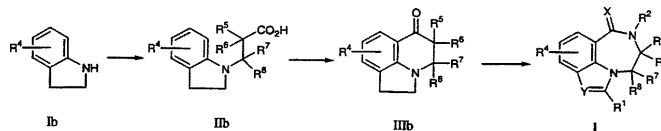
(IVa) (IVa) (acid chloride) (ring expansion) (Y = N, X = O) (Y = N) (Z = O, S) (II)

la) : (urea) (thiourea) (Va)

, Q가 (leaving group) (IIIa) (Va) (Y = CH)

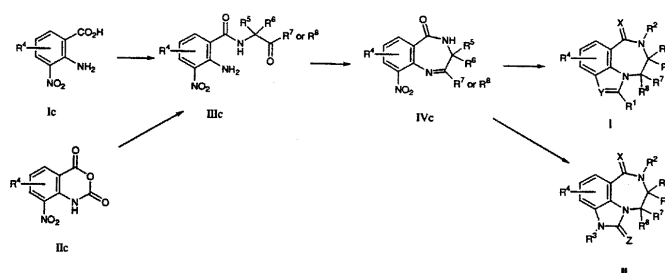
, Q C C - R₁) ,

B



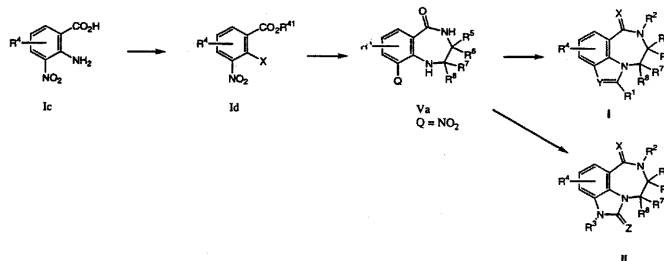
(IIIb) , (Ib) N - (IIb) , (Y = CH)

C



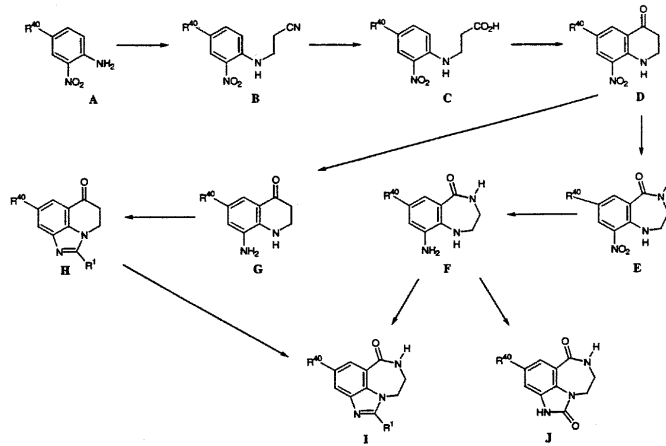
hydride) (IIc) - (nitro - anthranilic acid) (Ic) - (nitro - isotoic anhydride) (IVc) (IIIc) (functionality) (Y = N) (Z = O, S)

D



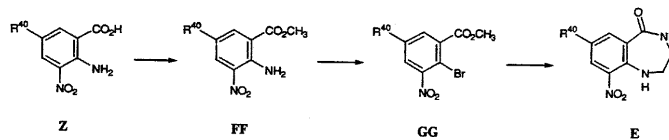
(Y = N) (Z = O, S) Va(Q = NO₂)
 (lc) (nitro - benzoic acid ester) (Id)
 (, X) , Va

1:



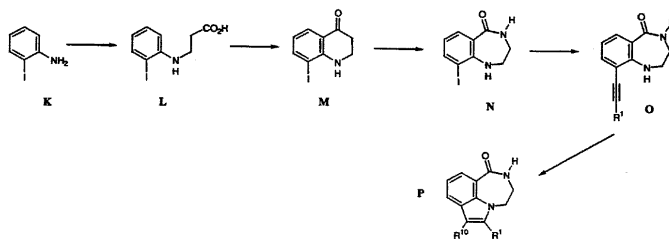
2- (A(R⁴⁰ = H, F) N- B B
 가 (Friedel - Cra
 ft - type intramolecular cyclization) D D
 G가 H(R¹ =)
 H NaN₃ (Schmidt - type reaction)
 (lactam) I D , E
 F , CS₂, (thiophosgene),
 가 I(R¹ = , SH) F (p
 hosgene), J , I
 R¹

1a: E



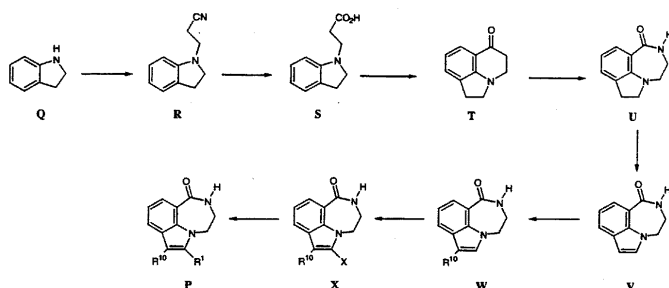
3- Z(R⁴⁰ = H) FF(R⁴⁰ = H) FF(R⁴⁰ = H)
 (diazotization) GG(R⁴⁰ = H)
 E(R⁴⁰ = H)

2:



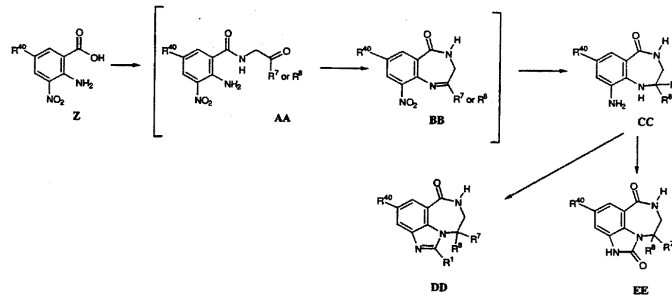
(I) 2-iodoaniline (K) is reacted with NaN_3 (palladium) to form compound L. Compound L is then converted to M, which is further converted to N. Compound N is converted to O, which is then converted to P. The substituents R^1 and R^{10} are defined as $-\text{Si}(\text{P})_3$.

3:



Q is reacted with NaN_3 to form R. R is converted to S, which is then converted to T. T is converted to U, which is then converted to V. V is converted to W, which is then converted to X. X is converted to P. The substituents R^1 and R^{10} are defined as $-\text{Si}(\text{P})_3$. $\text{R}^{10} = \text{I, CHO}$.

4:

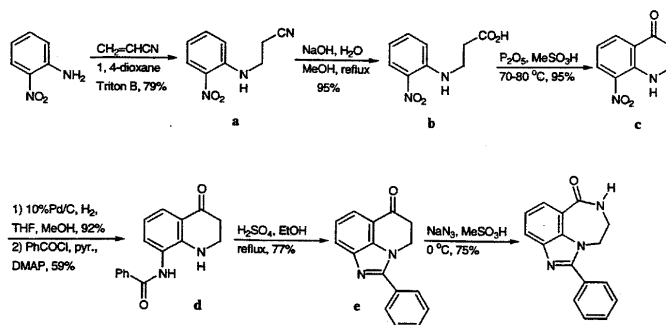


$Z (R^{40} = H)$
 $R^7, R^8, H, S_2, (R^1 = \text{SH}; R_7, R_8 = H, \text{etc.})$
 AA, BB, CC, DD, EE
 R^1, R^7

(proton magnetic resonance spectroscopy), (infrared spectroscopy),
 (elemental microanalysis), (mass spectrometry), (thin layer chromatography),
 (high performance liquid chromatography)

¹H NMR) 300 가 Tech - Mag Bruker Avance 300DPX Bruker Av
 ance 500DRX spectrometer 300 500 가 (MHz) (field strength)
 (chemical shift) (tetramethylsilane standard)
 (downfield) (ppm,) , ¹H NMR
 (residual protic solvent signals) : CHCl₃ = 7.26ppm; DMSO = 2.49ppm; C₆HD₅ = 7.1
 5ppm. (peak multiplicities) : s = (singlet); d = (doublet); d
 d = ; t = (triplet); q = ; br = (broad resonance); m = (multiplet).
 (coupling constant) (Hz) (IR) Perkin - Elmer 1600 ser
 ies Midac Corporation FTIR spectrometer Atlantic Microlab, Inc.
 Norcross, GA) Galbraith Laboratories(Nashville, TN) , ± 0.4%
 (flash) Silica 60(Merck Art 9385)
 (TLC) Silica 60 F254(Merck Art 5719) (sheets)
 HPLC 254nm 가 HP1100 , 50AUFS 0.0
 2 Hewlett Packard(HP) Series 1100 Quaternary system . Pheomenex
 Prodigy 5 ODS(3) (250mm × 4.6mm; 5μm) , 0.1% TFA 90% H₂O
 0.1% TFA 10% CH₃CN 20 , 0.1% TFA 35% H
 2O 0.1% TFA 65% CH₃CN 25 , 0.1% TFA 10% H₂O
 0.1% TFA 90% CH₃CN (gradient mobile phase)
 = 1Mℓ/ (preparative) HPLC Gilson 811c , Gilson Model 306
 , Gilson 215 (handler) 214 220 254nm Gilson Model 119 UV/가
 Gilson Model 806 Manometric module(50AUFS 0.02) . Me
 tasil AQ C18 (250mm × 212mm; 10μm)가 , 0.1% TFA 90% H₂O 0.
 1% TFA 10% CH₃CN 2 , 22 0.1% TFA 35%
 H₂O 0.1% TFA 65% CH₃CN ; 90% 0.1M NH₄OAc 10% CH₃CN 2
 , 22 100% CH₃CN (mobile phage)
 = 25Mℓ/ (mp) MelTemp , 가 ,
 (septum - sealed) ,
 : Et₂O() ; DMF(N,N -) ; DMSO(
) ; MeOH() ; EtOH() ; EtOAc() ; THF() ; Ac()
 ; Me() ; Et() ; , Ph().

1: 1 - - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6 -



(a) a - 3 - (2 -) - (maryanoff et al., J. Med. Chem. 38, 016(1995):)

2 - (22.4g, 159mmol) 1,4 - (160Mℓ) (12.68Mℓ, 190mmol)
 가 , 40 % (B) 0.50Mℓ 가
 1 , Et
 2O , EtOAc , 24.07g(79%
) : mp= 112 - 115 (Lit.109 - 112 (Kamenka et al.,J. Heterocycl. Chem.10, 459(1973); German
 Patent Publication DE 2056215)); R_f = 0.18(30% EtOAc/); ¹H NMR(CDCl₃) 2.77(t, 2H,J= 7.0 Hz),
 3.76(q, 2H,J= 6.8 Hz), 6.78 - 6.81(m, 1H), 6.88(d, 1H,J= 8.5 Hz), 7.52 - 7.55(m, 1H), 8.21(br, 1H), 8.25
 (dd, 1H,J= 8.6, 1.5 Hz).

(b) b - 3 - (2 -) - (Kamenka et al.,J. Heterocycl.Chem.10, 459(1973))
 :

3 - (2 -) - a(25.45g, 133.12mmol) MeOH(250Mℓ) . 10% NaOH
 (250Mℓ) 가 , 3.5 . MeOH , H₂O
 , 10% HCl pH 2 - 3 , H₂O ,
 (26.47g, 95%) : mp= 146 - 147 (Lit.= 144
 - 145);¹H NMR(CDCl₃) 2.81(t, 2H,J= 6.7 Hz), 3.69 - 3.72(m, 2H), 6.70 - 6.73(m, 1H), 6.91(d, 1H,J=
 8.6 Hz), 7.48 - 7.51(m, 1H), 8.21(dd, 1H,J= 8.6, 1.5 Hz).

(c) c - 8 - - 2,3 - - 1H - - 4 - (Kamenka et al.,J. Heterocycl.Chem.10, 45
 9(1973)):

3 - (2 -) - b(26.89g, 127.93mmol) (Eaton's Reagent;
 7.5 % P₂O₅)(562g, 375Mℓ) 가 , 가 , 70 - 80 1.5
 가 , EtOAc , (orgnic phas
 e) H₂O (brine) , (MgSO₄),
 , Et₂O , 11.41g (46%): mp= 150 - 152 (Lit.= 144 - 145); R_f = 0.26(30% E
 tOAc/);¹H NMR(CDCl₃) 2.83(t, 2H,J= 7.0 Hz), 3.80 - 3.85(m, 2H), 6.76 - 6.81(m, 1H), 8.21 - 8.24
 (m, 1H), 8.35(br, 1H), 8.41(dd, 1H,J= 8.4, 1.5 Hz).

(d) d - N - (4 - - 1,2,3,4 - - 8 -) :

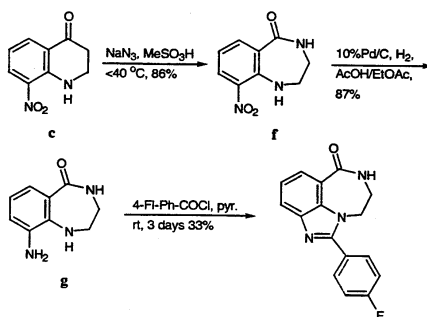
8 - - 2,3 - - 1H - - 4 - c(0.39g, 2.05mmol) THF(5Mℓ) MeOH(13Mℓ)
 . 10% Pd/C(0.06g) 가 , ,
 1,4 - (15Mℓ) , 4M HCl/ (1.07Mℓ) 가 , 5
 , Et₂O 가
 0.44g(92%) , (0.41g,
 1.76mmol) (9Mℓ) , 4 - (0.02g, 0.18mmol) 가 , ()
 0.23Mℓ, 1.94mmol) 가 (rt) , CH₂Cl
 2 , MgSO₄
 , (flash) , 0.28g(59%)
 (MeOH/EtOAc): mp= 232 - 234 ; R_f = 0.13(50% EtOAc/)
 ; IR(KBr) 1657, 1607, 1516cm⁻¹; ¹H NMR(DMSO - d₆) 2.51 - 2.59(m, 2H), 3.44 - 3.49(m, 2H), 6.42(br,
 1H), 6.63 - 6.68(m, 1H), 7.34 - 7.37(m, 1H), 7.50 - 7.63(m, 4H), 8.02 - 8.05(m, 2H), 9.72(s, 1H). LRMS(
 M+H) 267.

(e) e - 2 - - 4,5 - - [4,5,1 - ij] - 6 - :

d(0.032g, 0.12mmol) EtOH(2.5Mℓ) H₂SO₄(0.13Mℓ) 가 ,
 45 EtOAc/ NaHCO₃ ,
 H₂O , MgSO₄ ,
 (3 - 10% EtOAc/) , 0.23g(77%) : mp= 114 - 118 ; R_f =
 0.16(30% EtOAc/) ; IR(KBr) 1690, 1609, 1457cm⁻¹ ; ¹H NMR(DMSO - d₆) 3.10(t, 2H, J= 6.9 Hz), 4.
 78(t, 2H, J= 6.9 Hz), 7.36 - 7.38(m, 1H), 7.58 - 7.61(m, 4H), 7.96 - 7.98(m, 3H). LRMS(M⁺) 248.

(f) :
 (5Mℓ) e(0.14g, 0.55mmol) 0 가 (bath)
 , 가 NaN₃ (0.05g, 0.72mmol) 가 .
 1 , 10% NaOH (aq) pH 8.5가
 . EtOAc , (MgSO₄),
 (50 - 75% EtOAc/) , 0.108g
 : mp= 255 - 257 ; R_f = 0.13(90% EtOAc/) ; IR(KBr) 1661, 1478cm⁻¹ ; ¹H NMR(DMSO - d₆) 3.52
 - 3.53(m, 2H), 4.45 - 4.46(m, 2H), 7.34 - 7.37(m, 1H), 7.57 - 7.60(m, 3H), 7.85 - 7.91(m, 4H), 8.43(t, 1H,
 J= 5.6 Hz). HRMS calcd for C₁₆H₁₃N₃O 263.1059(M⁺), found 263.1068. Anal.(C₁₆H₁₃N₃O) C, H, N.

2: 1 - (4 -) - 8,9 - - 7HH - 2,7,9aa - - [cdcd] - 6 -

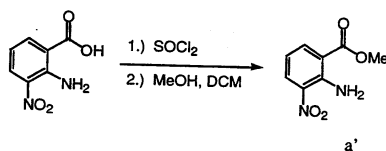


(a) f - 9 - - 1,2,3,4 - - [e][1,4] - 5 - :
 c 8 - - 2,3 - - 1H - - 4 - (1.96g, 10.2mmol) (50Mℓ)
 , 40 가 . 가
 40 , NaN₃ (0.86g, 13.24mmol) 가 .
 가 1 , 10% NaOH pH 10
 , H₂O , 1.46g .
 EtOAc , (MgSO₄) , , 0.57g
 가 , (20% EtOAc/CHCl₃)
 1.80g(86%) : mp= 190 - 192 ; R_f = 0.11(40% EtOAc/CHCl₃) ; IR(KBr) 165
 3, 1603, 1262cm⁻¹ ; ¹H NMR(DMSO - d₆) 3.33 - 3.35(m, 2H), 3.61 - 3.64(m, 2H), 6.72 - 6.75(m, 1H), 8.
 12 - 8.14(m, 1H), 8.20 - 8.22(m, 1H), 8.38(s, 1H), 8.68(s, 1H). LRMS(M⁺) 207. Anal.(C₉H₉N₃O₃) C, H, N.

(b) :

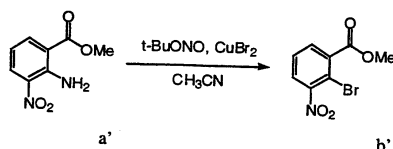
(Parr shaker bottle) , f 9 - - 1,2,3,4 - - [e][1,4]
 - 5 - (3.0g, 14mmol) EtOAc(70Mℓ) (30Mℓ) . 10% Pd/C(0.60g)
 가 , 50psi . 12 ,
 , AcOH EtOH . EtOAc 가 ,
 . EtOAc . EtOH .
 g(9 - - 1,2,3 - - [e][1,4] - 5 -)가 2.
 24g(87%) , g(0.22g, 1.27mmol) (3
 7Mℓ) , 4 - (0.17Mℓ, 1.40mmol) 가 .
 (60 - 90% EtO
 Ac/) , 0.12g(33%) : mp= 264 - 266 ; R_f = 0.13(90% EtOAc/) ; IR(
 KBr) 1653, 1601, 1480, 1223cm⁻¹ ; ¹H NMR(DMSO - d₆) 3.52 - 3.53(m, 2H), 4.43 - 4.44(m, 2H), 7.34 - 7.
 37(m, 1H), 7.41 - 7.44(m, 2H), 7.86 - 7.93(m, 4H), 8.44(t, 1H, J= 5.6 Hz). HRMS calcd for C₁₆ H₁₂ N₃ OF
 281.0964(M⁺), found 281.0963. Anal.(C₁₆ H₁₂ N₃ OF) C, H, N.

f :



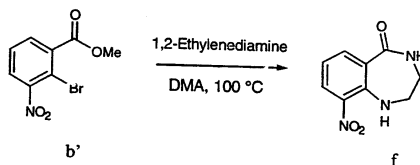
(c) a' - 2 - - 3 - - :

2 - - 3 - - (6.30g, 34.6mmol) (neat thionyl chloride)
 100Mℓ CH₂Cl₂ , 0 . 20Mℓ CH₂Cl₂ MeOH ,
 20Mℓ (funnel) 가 .
 (Fisher esterification) . 5.40g(78%)
 (, 0 , HCl 가 , 가 가 MeOH
 .)



(d) b' - 2 - - 3 - - :

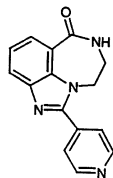
2 - 3 - (5.00g, 25.5mmol) () (6.80g, 30.5mmol) 0 12
 5Mℓ 4.5Mℓ tert - (37.8mmol) 가 .
 , 23 가 , 200Mℓ 10% HCl , Et₂O 4 .
 10% HCl, (MgSO₄),
 6.00g(90%) , 가 : IR(KBr) 1736, 1529,
 1429, 1363, 1292, 1275, 1211, 1138, 1035, 976, 885, 814, 767, 733, 706cm⁻¹; ¹H NMR(CDCl₃) 3.98(s,
 3H), 7.53(t, 1H, J= 7.7 Hz), 7.77(d, 1H, J= 7.7 Hz), 7.86(d, 1H, J= 7.7 Hz). Anal.(C₈H₆BrNO₄) C, H, N.



(e) 9 - 1,2,3,4 - [e] - 5 - (f):

2 - 3 - (0.50g, 1.92mmol) 1,2 - (250μℓ, 3.74mmol) 5Mℓ D
 MA 100 가 , , 200
 Mℓ 1M NaH₂PO₄ , 4 .
 , 256mg(1.23mmol, 64%) ,
 HPLC , CH₂Cl₂ (3 x 150Mℓ).
 (MgSO₄), , (eluent) 2.5% 5% MeOH/CH₂Cl₂
 , 125mg(0.60mmol, 31%) .

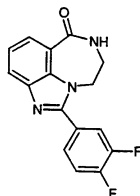
3: 1 - 4 - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 - :



g(0.088g, 0.50mmol) (5Mℓ) .
 (hydrochloride) (0.093g, 0.50mmol) 가 , .
 가 , ;
 4:1 CHCl₃/iPrOH , 0.5N Na₂CO₃ , 4:1
 CHCl₃/iPrOH , (MgSO₄),
 (5 - 10% MeOH/EtOAc) 0.055g(55%) (tan)
 : mp= 269 (dec); R_f = 0.13(20% MeOH/EtOAc); IR(KBr) 1653, 1609, 1472cm⁻¹; ¹H NMR(DMSO - d₆)
 3.54 - 3.55(m, 2H), 4.51 - 4.52(m, 2H), 7.38 - 7.42(m, 1H), 7.86 - 7.87(m, 2H), 7.91 - 7.93(m, 1H), 7.9
 5 - 7.97(m, 1H), 8.47(t, 1H, J= 5.6 Hz), 8.79 - 8.80(m, 2H). HRMS calcd for C₁₅H₁₂N₄O 264.2022(M⁺),
 found 264.1008. Anal.(C₁₅H₁₂N₄O · 0.25 H₂O) C, H, N.

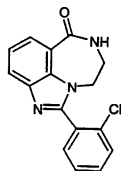
7,9a - 4 - 6, 8 - 11, 14 66 - 68 , 1 - (4 -) - 8,9 - - 7H - 2, g
 [cd] - 6 - 2 ,
 7,9a - 7, 12 15 - 17 , 1 - - 4 - - 8,9 - - 7H - 2, g
 [cd] - 6 - 3 ,

4: 1 - (3,4 -) - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -



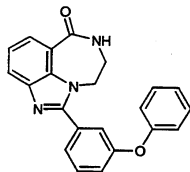
72 (55%) : mp= 245 - 247 ; R_f = 0.18(90% EtOAc/); IR(KBr) 1665, 1497cm⁻¹; ¹H NMR(DMSO - d₆) 3.53 - 3.54(m, 2H), 4.46 - 4.47(m, 2H), 7.36 - 7.39(m, 1H), 7.64 - 7.68(m, 1H), 7.70 - 7.73(m, 1H), 7.88 - 7.92(m, 2H), 7.94 - 7.98(m, 1H), 8.46(t, 1H, -J= 5.7 Hz). HRMS calcd for C₁₆H₁₁N₃OF₂ 299.0870(M⁺), found 299.0857. Anal.(C₁₆H₁₁N₃OF₂) C, H, N.

5: 1 - (2 -) - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -



75 ; 72 (50%) : mp= 253 - 255 ; R_f = 0.16(90% EtOAc/); IR(KBr) 1665, 1468, 1389cm⁻¹; ¹H NMR(DMSO - d₆) 3.54 - 3.58(m, 2H), 4.09 - 4.12(m, 2H), 7.36 - 7.42(m, 1H), 7.52 - 7.72(m, 4H), 7.91 - 7.95(m, 2H), 8.43(t, 1H, J= 5.5 Hz). HRMS calcd for C₁₆H₁₂N₃OCl 297.0668(M⁺), found 297.0677. Anal.(C₁₆H₁₂N₃OCl · 0.25 H₂O) C, H, N.

6: 1 - (3 -) - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -



(a) 3 -

:

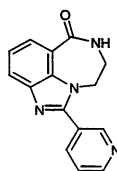
1052390 (1.95g, 9.10mmol) (0.89g, 10.01mmol) 가 , CH₂Cl₂ (45Ml) 3 -
 , DMF ,
 Et₂O ,
 . Et₂O ,

(short path vacuum distillation) (bp= 139 /3mm Hg) , 1.12g(53%) :
 IR(neat) 1755, 1584cm⁻¹; ¹H NMR(CDCl₃) 7.02 - 7.05(m, 2H), 7.16 - 7.21(m, 1H), 7.29 - 7.33(m, 1H),
 7.37 - 7.49(m, 3H), 7.70 - 7.71(m, 1H), 7.84 - 7.87(m, 1H).

(b) :

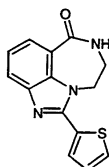
; 72 , (49%) : mp= 216 - 219 ;
 R_f = 0.29(90% EtOAc/); IR(KBr) 1661, 1456, 1219cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.53(m, 2H), 4.
 45 - 4.47(m, 2H), 7.11 - 7.13(m, 2H), 7.18 - 7.22(m, 2H), 7.33 - 7.36(m, 1H), 7.42 - 7.45(m, 3H), 7.57 - 7.
 61(m, 2H), 7.85 - 7.89(m, 2H), 8.43(t, 1H, J= 5.7 Hz). HRMS calcd for C₂₂H₁₇N₃O₂ 355.1321(M⁺), found
 355.1308. Anal.(C₂₂H₁₇N₃O₂) C, H, N.

7: 1 - - 3 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



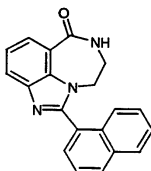
; 72 , (67%) : mp= 250 (dec); R_f
 = 0.16(20% MeOH/EtOAc); IR(KBr) 1663, 1385, 1310cm⁻¹; ¹H NMR(DMSO - d₆) 3.54 - 3.56(m, 2H),
 4.48 - 4.49(m, 2H), 7.39(t, 1H, J= 7.7 Hz), 7.62(dd, 1H, J= 8.1, 5.0 Hz), 7.90(dd, 1H, J= 7.8, 1.0 Hz), 7.9
 4(dd, 1H, J= 7.9, 1.9 Hz), 8.28(dt, 1H, J= 7.9, 1.9 Hz), 8.46(t, 1H, J= 5.7 Hz), 8.75(dd, 1H, J= 4.9, 1.3 H
 z), 9.05(d, 1H, J= 1.9 Hz). HRMS calcd for C₁₅H₁₂N₄O 264.1011(M⁺), found 264.1013. Anal.(C₁₅H₁₂N₄
 O • 0.4H₂O) C, H, N.

8: 1 - - 2 - - 8,9 - - 7HH - 2,7,9a - - [cd] - 6 -



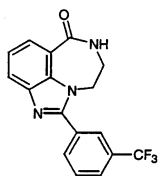
; 72, (63%) : mp= 247 - 250 ; R_f = 0.21(5% MeOH/CHCl₃); IR(KBr) 1661, 1474, 737cm⁻¹; ¹H NMR(DMSO - d₆) 3.59 - 3.60(m, 2H), 4.56 - 4.57(m, 2H), 7.29(dd, 1H, J= 5.0, 3.8 Hz), 7.35(t, 1H, J= 7.8 Hz), 7.72(d, 1H, J= 3.7 Hz), 7.84 - 7.87(m, 3H), 8.45(t, 1H, J= 5.6 Hz). HRMS calcd for C₁₄H₁₁N₃OS 269.0622(M⁺), found 269.0627. Anal.(C₁₄H₁₁N₃OS) C, H, N.

9: 1 - - 1 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



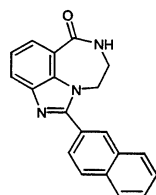
70 ; 72, (53%) : mp= 223 - 225 (dec) ; R_f = 0.18(90% EtOAc/); IR(KBr) 1659, 1464, 1312cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.54(m, 2H), 4.11 - 4.12(m, 2H), 7.41(t, 1H, J= 7.8 Hz), 7.53 - 7.64(m, 2H), 7.67 - 7.72(m, 1H), 7.81(dd, 1H, J= 7.1, 1.2 Hz), 7.89(d, 1H, J= 8.3 Hz), 7.96(dt, 2H, J= 7.7, 1.0 Hz), 8.06 - 8.09(m, 1H), 8.17(d, 1H, J= 8.2 Hz), 8.40(t, 1H, J= 5.7 Hz). HRMS calcd for C₂₀H₁₅N₃O 313.1215(M⁺), found 313.1204. Anal.(C₂₀H₁₅N₃O) C, H, N.

10: 1 - (3 - -) - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



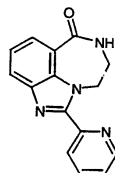
; 72, (53%) : mp= 250 - 252 ; R_f = 0.18(90% EtOAc/); IR(KBr) 1669, 1393, 1325cm⁻¹; ¹H NMR(DMSO - d₆) 3.53 - 3.54(m, 2H), 4.48 - 4.49(m, 2H), 7.34(t, 1H, J= 7.8 Hz), 7.80 - 7.86(m, 1H), 7.92(ddd, 1H, J= 8.5, 8.0, 1.1 Hz), 7.94 - 7.95(m, 1H), 7.96 - 7.97(m, 1H), 8.16 - 8.19(m, 2H), 8.47(t, 1H, J= 5.7 Hz). HRMS calcd for C₁₇H₁₂N₃OF₃ 331.0932(M⁺), found 331.0944. Anal.(C₁₇H₁₂N₃OF₃) C, H, N.

11: 1 - - 2 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



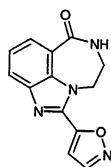
; 72, (32%) : mp= 259 - 261 ; R_f = 0.16(90% EtOAc/); IR(KBr) 1659, 1466, 1395, 1308cm⁻¹; ¹H NMR(DMSO - d₆) 3.55 - 3.57(m, 2H), 4.57 - 4.59(m, 2H), 7.38(t, 1H, J= 7.8 Hz), 7.62 - 7.65(m, 2H), 7.89(dd, 1H, J= 7.7, 1.1 Hz), 7.94(dd, 1H, J= 7.9, 1.1 Hz), 7.99 - 8.05(m, 2H), 8.08 - 8.13(m, 2H), 8.45 - 8.46(m, 1H), 8.49(t, 1H, J= 5.7 Hz). HRMS calcd for C₂₀ H₁₅ N₃ O 313.1215(M⁺), found 313.1221. Anal.(C₂₀ H₁₅ N₃ O • 0.15H₂O) C, H, N.

12: 1 - - 2 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



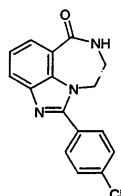
; 72, (tan) (52%) : mp= 249 - 250 ; R_f = 0.26(10% MeOH/EtOAc); IR(KBr) 1659, 1605, 1443cm⁻¹; ¹H NMR(DMSO - d₆) 3.57 - 3.62(m, 2H), 4.60 - 5.20(br, 2H), 7.39(t, 1H, J= 7.8 Hz), 7.55(ddd, 1H, J= 7.7, 4.9, 1.2 Hz), 7.92 - 7.96(m, 2H), 8.03(d t, 1H, J= 7.7, 1.8 Hz), 8.29 - 8.32(m, 1H), 8.45(t, 1H, J= 5.5 Hz), 8.75 - 8.77(m, 1H). HRMS calcd for C₁₅ H₁₂ N₄ O 264.1011(M⁺), found 264.1001. Anal.(C₁₅ H₁₂ N₄ O) C, H, N.

13: 1 - - 5 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



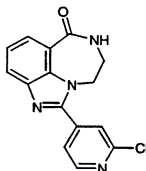
; 72, (21%) : mp= 226 (dec); R_f = 0.08(5% MeOH/CHCl₃); IR(KBr) 1661, 1466, 1379cm⁻¹; ¹H NMR(DMSO - d₆) 3.61 - 3.66(m, 2H), 4.65 - 4.67(m, 2H), 7.28(d, 1H, J= 2.0 Hz), 7.41 - 7.46(m, 1H), 7.95 - 7.97(m, 1H), 7.98 - 7.80(m, 1H), 8.50(t, 1H, J= 5.7 Hz), 8.90(d, 1H, J= 2.0 Hz). HRMS calcd for C₁₃ H₁₀ N₄ O₂ 254.0804(M⁺), found 254.0798. Anal.(C₁₃ H₁₀ N₄ O₂) C, H, N.

14: 1 - (4 - -) - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



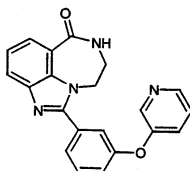
; 72, (off - white) (47%)
 : mp= 272 - 274 ; R_f= 0.26(90% EtOAc/); IR(KBr) 1663, 1597, 1464, 1408cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.54(m, 2H), 4.44 - 4.46(m, 2H), 7.37(t, 1H, J= 7.8 Hz), 7.64 - 7.66(m, 2H), 7.86 - 7.92(m, 4 H), 8.44 - 8.47(m, 1H). HRMS calcd for C₁₆H₁₂N₃OCl 297.0669(M⁺), found 297.0667. Anal.(C₁₆H₁₂N₃O Cl) C, H, N

15: 1 - (2 - - 4 -) - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -



; 72, (47%) : mp= 265 (dec); R_f = 0.20(5% MeOH/EtOAc); IR(KBr) 1661, 1607, 1464, 1399cm⁻¹; ¹H NMR(DMSO - d₆) 3.35 - 3.39(m, 2 H), 3.54 - 3.55(m, 2H), 7.39 - 7.44(m, 1H), 7.89 - 7.98(m, 4H), 8.50(t, 1H, J= 5.8 Hz), 8.63(d, 1H, J= 5.2 Hz). HRMS calcd for C₁₅H₁₁N₄OCl 298.0621(M⁺), found 298.0617. Anal.(C₁₅H₁₁N₄OCl · 0.25 H₂O) C, H, N.

16: 1 - [3 - (- 3 -) -] - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -



(a) 3 - (- 3 -) - - :

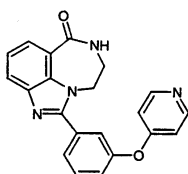
6N HCl(2Ml) 3 - (- 3 -) (Butler et al., J. Med. Chem. 24, 346(1981), 0.229g, 1.0mmol) 18 60 (tan) 0.244g(97%) : mp= 208 - 210 ; ¹H NMR(DMSO - d₆) 7.46(m, 1H), 7.60(m, 2H), 7.83(m, 2H), 7.98(m, 1H), 8.60(dd, 1H, J= 5.1, 0.9 Hz), 8.70(d, 1H, J= 2.6 Hz), 9.30 - 11.90(br, 2H). Anal. (C₁₂H₁₀NO₃Cl) C, H, N.

(b) 3 - (- 3 -) - :

, 3 - (- 3 -) - HCl (99%,): IR(KBr) 1751 cm⁻¹; ¹H NMR(CDCl₃) 7.45 - 7.49(m, 1H), 7.66 - 7.72(m, 1H), 7.86 - 7.92(m, 2H), 7.97 - 8.01(m, 1H), 8.12 - 8.15(m, 1H), 8.39 - 8.40(m, 1H), 8.53 - 8.55(m, 1H).

(c) :
 ; 72 , (55%) : mp= 223 - 225 ; R_f
 = 0.18(10% MeOH/EtOAc); IR(KBr) 1665, 1571, 1460cm⁻¹; ¹H NMR(CDCl₃) 3.52 - 3.53(m, 2H), 4.45 -
 4.48(m, 2H), 7.27 - 7.38(m, 2H), 7.44 - 7.68(m, 5H), 7.85 - 7.91(m, 2H), 8.41 - 8.48(m, 3H). HRMS calcd
 for C₂₁H₁₆N₄O₂ 356.1273(M⁺), found 356.1263. Anal.(C₂₁H₁₆N₄O₂ · 0.25 H₂O) C, H, N.

17: 1 - [3 - (- 4 -) -] - 8,9 - - 7 HH - 2,7,9aa - - [cdcd] - 6 -



(a) 3 - (- 4 -) (Butler et al., J. Med. Chem. 14, 575(1971):

H₂SO₄ (5.4Mℓ) 4 - [3 - ()] ¹ (1.89g, 7.9 mmol) 120 16
 가 , MeOH(200Mℓ) 가 2
 , 가 , 350Mℓ Et₂O . NaHC
 O₃ 가 , Na₂CO₃ 가 . pH가
 , (Celite)
 CH₂Cl₂ , (Na₂SO₄),
 1.62(89%) : ¹H NMR(DMSO - d₆) 3.84(s, 3H), 6.96(d, 2H, J= 6.3 Hz), 7.49(dd, 1H, J= 8.
 1, 2.5 Hz), 7.64(m, 2H), 7.87(d, 1H, J= 7.7 Hz), 8.49(d, 2H, J= 6.0 Hz).

(b) 3 - (- 4 -) - - :

6N HCl(6Mℓ) 3 - (- 4 -) (0.229g, 1.0mmol) 18
 , 60 , 0.25g(99%) : mp= 230 - 23
 3 ; ¹H NMR(DMSO - d₆) 7.48(d, 2H, J= 6.9 Hz), 7.63(m, 1H), 7.73(t, 1H, J= 8.0 Hz), 7.82(s, 1H), 7.9
 9(d, 1H, J= 7.8 Hz), 8.80(d, 2H, J= 7.2 Hz), 12.8 - 14.1(br, 2H). Anal.(C₁₂H₁₀NO₃Cl) C, H, N.

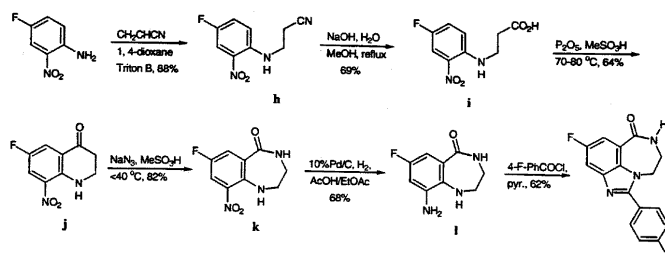
(c) 3 - (- 4 -) - :

3 - (- 4 -) - HCl (99%,) : IR(KBr) 1736, 1
 709, 1501cm⁻¹; ¹H NMR(CDCl₃) 7.29 - 7.32(m, 2H), 7.52 - 7.54(m, 1H), 7.73 - 7.78(m, 1H), 7.94(s, 1H),
 8.20 - 8.22(m, 1H), 8.68 - 8.70(m, 2H).

(d) :

; 72 , (52%) : mp= 245 - 247 ; R_f
 = 0.24(15% MeOH/EtOAc); IR(KBr) 1661, 1576, 1264cm⁻¹; ¹H NMR(DMSO - d₆) 3.53 - 3.55(m, 2H), 4.
 48 - 4.49(m, 2H), 7.03(d, 2H, J= 6.2 Hz), 7.33 - 7.42(m, 2H), 7.66 - 7.72(m, 2H), 7.78 - 7.80(m, 1H), 7.86
 - 7.92(m, 2H), 8.43 - 8.47(m, 1H), 8.50(d, 2H, J= 6.2 Hz). HRMS calcd for C₂₁H₁₆N₄O₂ 356.1273(M⁺),
 found 356.1264. Anal.(C₂₁H₁₆N₄O₂) C, H, N.

18: 4 - - 1 - (4 - -) - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] -
6 -



(a) h - 3 - (4 - - 2 -) - :
a , 3 - (4 - - 2 -) - B(0.2Mℓ)
4 - - 2 - (3.17g, 19.68mmol), (1.57Mℓ, 23.61mmol) B(0.2Mℓ)
88% : mp= 140 - 142 ; R_f = 0.16(30% EtOAc/); IR(KBr)
3380, 3117, 2955, 2251, 1526cm⁻¹; ¹H NMR(CDCl₃) 2.73 - 2.76(m, 2H), 3.69 - 3.73(m, 2H), 6.83 - 6.86
(m, 1H), 7.30 - 7.34(m, 1H), 7.95(dd, 1H, J= 8.9, 3.0 Hz), 8.05(br, 1H). Anal.(C₉H₈N₃O₂F) C, H, N.

(b) i - 3 - (4 - - 2 -) - :
b , 3 - (4 - - 2 -) -
h , 0.94g(69%) - : mp= 154 - 155 ; IR(K
Br) 3391, 1721, 1526cm⁻¹; ¹H NMR(CDCl₃) 2.76 - 2.79(m, 2H), 3.64 - 3.68(m, 2H), 6.85 - 6.88(m, 1H),
7.28 - 7.30(m, 1H), 7.91(dd, 1H, J= 9.0, 2.9 Hz), 8.07(br, 1H). Anal.(C₉H₉N₂O₄) C, H, N.

(c) j - 6 - - 8 - - 2,3 - - 1H - - 4 - :
i(0.65g, 2.84mmol) (Eaton's Reagent; 7.5 % P₂O₅)(
11Mℓ) 가 . 60 3.5 가 ,
, 가 ,
(5 - 10% EtOAc/) , 0.38g(6
4%) : mp= 155 - 157 ; R_f = 0.26(30% EtOAc/); IR(KBr) 3389, 3057, 1692,
1514cm⁻¹; ¹H NMR(CDCl₃) 2.82(t, 2H, J= 7.1 Hz), 3.76 - 3.81(m, 2H), 7.96(dd, 1H, J= 7.6, 3.2 Hz), 8.
13(dd, 1H, J= 8.3, 3.2 Hz), 8.15(br, 1H). Anal.(C₉H₇N₂O₃) C, H, N.

(d) k - 7 - - 9 - - 1,2,3,4 - - [cd] - - 5 -
f , 6 - - 8 - - 2,3 - - 1H - - 4
- j , 0.33g(82%) - : mp=
215 - 217 ; R_f = 0.11(40% EtOAc/CHCl₃); IR(KBr) 1651, 1514, 1258, 1161cm⁻¹; ¹H NMR(DMSO - d₆)
3.29 - 3.36(m, 2H), 3.59 - 3.63(m, 2H), 7.98(dd, 1H, J= 9.5, 3.4 Hz), 8.10(dd, 1H, J= 8.4, 3.4 Hz), 8.52 -
8.56(m, 2H). Anal.(C₉H₈N₃O₃F) C, H, N.

(e) :

g(2) , k l 68%

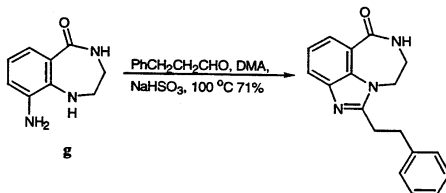
2 l 4-

, 0.096g(62%)

: mp= 284 - 287 ; R_f = 0.13(90% EtOAc/);

IR(KBr) 1661, 1603, 1485cm⁻¹; ¹H NMR(DMSO - d₆) 3.54 - 3.57(m, 2H), 4.43 - 4.45(m, 2H), 7.41 - 7.47 (m, 2H), 7.60(dd, 1H, J= 10.6, 2.6 Hz), 7.76(dd, 1H, J= 9.0, 2.6 Hz), 7.89 - 7.94(m, 2H), 8.61(t, 1H, J= 5.6 Hz). HRMS calcd for C₁₆H₁₁N₃O₂ 299.0870(M⁺), found 299.0858. Anal.(C₁₆H₁₁N₃O₂) C, H, N.

19: 1 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



(Higgins et al., J. Polym. Sci. Part A - 1(19

70), 8: 171 - 177; Imai et al., Synthesis(1981), 35 - 36).

g(0.048g, 0.27mmol)

(DMA) (1.50Mℓ)

(90%, 0.039Mℓ, 0.27mmol) DMA 가

(sodium bisulfate) (0.042g, 0.40mmol) 가

100 1 가

EtOAc/H₂O

(MgSO₄),

(0 - 1% MeOH/EtOAc) , 0.

055g(71%)

: mp= 225 - 226 ; R_f = 0.26(5% MeOH/EtOAc); IR(KBr) 1655, 1603, 15

05, 1468cm⁻¹; ¹H NMR(DMSO - d₆) 3.07 - 3.18(m, 4H), 3.48 - 3.49(m, 2H), 4.15 - 4.30(m, 2H), 7.18 - 7.

23(m, 1H), 7.26 - 7.28(m, 5H), 7.76 - 7.81(m, 2H), 8.31(t, 1H, J= 5.6 Hz). HRMS calcd for C₁₈H₁₇N₃O₂

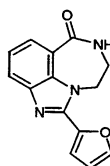
91.1372(M⁺), found 291.1368. Anal.(C₁₈H₁₇N₃O₂ · 0.10H₂O) C, H, N.

20 - 24, 30, 55 - 57, 61 - 65, 68, 73 - 74 78 - 80 , 1 - - - 8,9 - - 7H - 2,7,

9a - - [cd] - 6 -

4 , g

20: 1 - - 2 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



74%

: mp= 278 - 279 ; R_f = 0.13(90% EtOAc/); IR(K

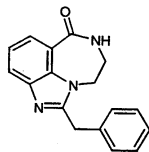
Br) 1655, 1464, 1437, 746cm⁻¹; ¹H NMR(DMSO - d₆) 3.58 - 3.63(m, 2H), 4.59 - 4.62(m, 2H), 6.79(dd,

1H, J= 3.5, 1.7 Hz), 7.25(dd, 1H, J= 3.5, 0.6 Hz), 7.35(t, 1H, J= 7.8 Hz), 8.02(dd, 1H, J= 1.7, 0.6 Hz), 8.

45(t, 1H, J= 5.6 Hz). HRMS calcd for C₁₄H₁₁N₃O₂ 253.0851(M⁺), found 253.0852. Anal.(C₁₄H₁₁N₃O₂)

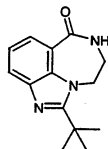
C, H, N.

21: 1 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



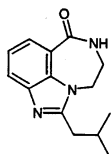
47% : mp= 226 - 228 ; R_f = 0.13(90% EtOAc/); IR(KBr) 1661, 1468, 1316cm⁻¹; ¹H NMR(CDCl₃) 3.65 - 3.67(m, 2H), 4.13 - 4.25(m, 2H), 4.36(s, 2H), 6.61 - 6.68(m, 1H), 7.18 - 7.41(m, 6H), 7.95 - 7.98(m, 1H), 8.08 - 8.10(m, 1H). HRMS calcd for C₁₇H₁₅N₃O 277.1215(M⁺), found 277.1203. Anal.(C₁₇H₁₅N₃O) C, H, N.

22: 1 - tert - - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -



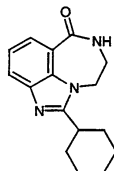
36% : mp= 246 - 248 ; R_f = 0.13(EtOAc); IR(KBr) 1634, 1464, 1360cm⁻¹; ¹H NMR(DMSO - d₆) 1.47(s, 9H), 3.57 - 3.59(m, 2H), 4.35 - 4.70(br, 2H), 7.25(t, 1H, J= 7.8 Hz), 7.77(dd, 1H, J= 7.9, 1.1 Hz), 7.82(dd, 1H, J= 7.7, 1.1 Hz), 8.37(t, 1H, J= 5.7 Hz). HRMS calcd for C₁₄H₁₇N₃O 243.1372(M⁺), found 243.1371. Anal.(C₁₄H₁₇N₃O) C, H, N.

23: 1 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



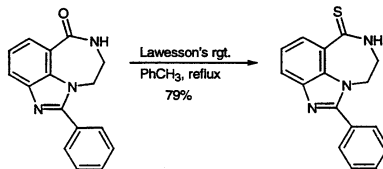
51% : mp= 211 - 212 ; R_f = 0.19(5% MeOH/EtOAc); IR(KBr) 1659, 1474, 1404cm⁻¹; ¹H NMR(DMSO - d₆) 0.96(d, 6H, J= 6.6 Hz), 2.15 - 2.18(m, 1H), 2.73(d, 2H, J= 7.1 Hz), 3.54 - 3.58(m, 2H), 4.35 - 4.40(m, 2H), 7.25(t, 1H, J= 7.8 Hz), 7.75 - 7.80(m, 2H), 8.33(t, 1H, J= 5.5 Hz). HRMS calcd for C₁₄H₁₇N₃O 243.1372(M⁺), found 243.1382. Anal.(C₁₄H₁₇N₃O) C, H, N

24: 1 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



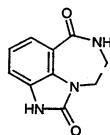
63% : mp= 265 - 266 ; R_f = 0.30(5% MeOH/EtOAc); IR(KBr) 1657, 1462, 756cm⁻¹; ¹H NMR(DMSO - d₆) 1.22 - 1.96(m, 10H), 2.88 - 2.97(m, 1H), 3.55 - 3.57(m, 2H), 4.30 - 4.50(m, 2H), 7.21 - 7.27(m, 1H), 7.74 - 7.80(m, 2H), 8.32(t, 1H, J= 5.5 Hz). HRMS calcd for C₁₆ H₁₉ N₃ O 269.1528(M⁺), found 269.1531. Anal.(C₁₆ H₁₉ N₃ O · 0.1 H₂O) C, H, N.

25: 1 - - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -



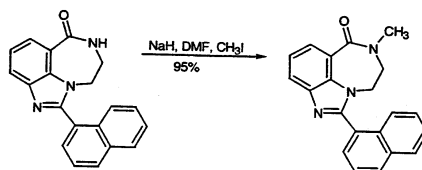
1 - - 8,9 - - 7 H - 2,7,9a - - [cd] - 6 - (1, 0.068g, 0.26mmol) (3Mℓ) , (Lawesson's reagent; 0.054g, 0.26mmol) 가 . 1 (20 - 50% EtOAc/) , 0.057g(79%) : mp= 224 (dec); R_f = 0.21(50% EtOAc/); IR(KBr) 1508, 1476, 1381, 1273cm⁻¹; ¹H NMR(DMSO - d₆) 3.65 - 3.72(m, 2H), 4.45 - 4.55(m, 2H), 7.33 - 7.36(m, 1H), 7.57 - 7.59(m, 3H), 7.87 - 7.92(m, 3H), 8.31 - 8.32(m, 1H), 10.84(t, 1H, J= 5.9 Hz). HRMS calcd for C₁₆ H₁₃ N₃ S 279.0830(M⁺), found 279.0835. Anal.(C₁₆ H₁₃ N₃ S · 0.5 H₂O) C, H, N.

26: 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 1,6 -



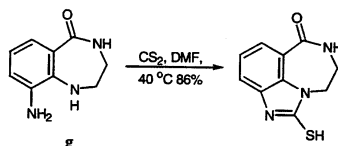
g(0.052g, 0.29mmol) DMF(3Mℓ) , 1,1' - (0.058g, 0.36mmol) 가 . 100 1 가 . 0.048g 가 (20 - 50% EtOAc/) , 0.014g(24%) : mp= 308 - 309 (dec); R_f = 0.42(20% MeOH/EtOAc) ; ¹H NMR(DMSO - d₆) 3.44 - 3.49(m, 2H), 3.86 - 3.89(m, 2H), 7.05(t, 1H, J= 7.7 Hz), 7.14(dd, 1H, J= 7.6, 1.3 Hz), 7.55(dd, 1H, J= 7.9, 1.3 Hz), 8.29(t, 1H, J= 5.5 Hz), 11.12(s, 1H). HRMS calcd for C₁₀ H₉ N₃ O₂ 203.0695(M⁺), found 203.0697. Anal.(C₁₀ H₉ N₃ O₂ · 0.2 H₂O) C, H, N.

27: 7 - - 1 - - 1 - - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -



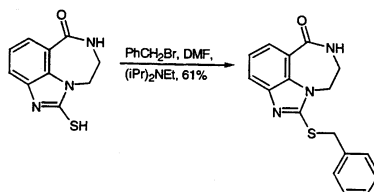
(60%, , 0.005g, 0.13mmol) DMF(1Mℓ)
 1 - - 1 - - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (9, 0.0
 35g, 0.11mmol) 가 , 가 15 . (0.008Mℓ, 0.1
 3mmol) 가 , 1 ,
 (50% EtOAc/) , 0.035g(95%) : mp= 126 (dec); R_f
 = 0.30(90% EtOAc/); ¹H NMR(DMSO - d₆) 3.14(s, 3H), 3.75 - 3.76(m, 2H), 4.15 - 4.26(m, 2H), 7.3
 9 - 7.44(m, 1H), 7.54 - 7.64(m, 2H), 7.67 - 7.72(m, 1H), 7.82 - 7.84(m, 1H), 7.92 - 8.00(m, 3H), 8.07 - 8.0
 9(m, 1H), 8.16 - 8.18(m, 1H). HRMS calcd for C₂₁H₁₇N₃O(M - H) 326.1293, found 326.1303. Anal.(C₂₁H
 17N₃O • 0.2 H₂O) C, H, N.

28: 1 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



g(0.024g, 0.13mmol) DMF(0.5Mℓ) . (carbon disulfide; 1.0Mℓ)
 가 , 40 3.5 가 . (0.025g, 86%)
 :¹H NMR(DMSO - d₆) 3.54 - 3.55(m, 2H), 3.80 - 4.80(br, 2H), 7.25 - 7.30(m, 1H), 7.35 - 7.37(m, 1H), 7.
 74 - 7.76(m, 1H), 8.44 - 8.48(m, 1H), 13.08(s, 1H). HRMS calcd for C₁₀H₉N₃OS 219.0466(M⁺), found 2
 19.0469.

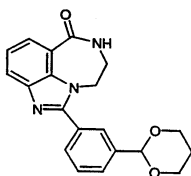
29: 1 - - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



DMF(1.0Mℓ) 1 - - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (0.026g, 0.
 12mmol, 가 28) (0.022Mℓ, 0.13mmol) 가 ,
 (0.014Mℓ, 0.13mmol) 가 .

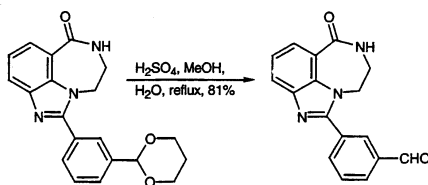
(50 - 60
 % EtOAc/) , 0.023g(61%) : mp= 189 - 191 ; R_f = 0.23(75% EtOAc/
); IR(KBr) 1651, 1462, 1445, 1356cm⁻¹; ¹H NMR(DMSO - d₆) 3.53 - 3.54(m, 2H), 4.14 - 4.15(m, 2H),
 4.61(s, 2H), 7.25 - 7.34(m, 4H), 7.45 - 7.47(m, 2H), 7.76 - 7.80(m, 2H), 8.36(t, 1H, J= 5.5 Hz). HRMS ca
 lcd for C₁₇H₁₅N₃OS 309.0936(M⁺), found 309.0933. Anal.(C₁₇H₁₅N₃OS • 0.3H₂O) C, H, N.

30: 1 - (3 - [1,3] - - 2 - -) - 8,9 - - 7 HH - 2,7,9 aa - - [cdcd] - 6 -

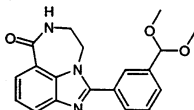


2 - (3 -) - 1,3 - (Ackerley et al., J. Med. Chem. (1995), 38: 1608)
 , 0.20g (52%) : mp = 247 (dec); $R_f = 0.22$ (5% MeOH/EtOAc); IR (KBr)
 r) 2361, 1653, 1472 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 1.32 - 1.50 (m, 1H), 1.95 - 2.08 (m, 1H), 3.52 - 3.53 (m, 2
 H), 3.97 (ddd, 2H, $J = 12.1, 12.1, 2.1$ Hz), 4.17 (dd, 2H, $J = 11.0, 5.1$ Hz), 4.43 - 4.45 (m, 2H), 5.63 (s, 1H),
 7.33 - 7.39 (m, 1H), 7.54 - 7.60 (m, 2H), 7.82 - 7.91 (m, 4H), 8.44 (t, 1H, $J = 5.5$ Hz). Anal. (C₂₀H₁₉N₃O₃) C,
 H, N.

31: 3 - (6 - - 6,7,8,9 - - 2,7,9 aa - - [cdcd] - 1 -) -

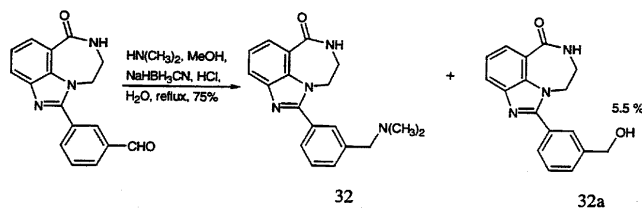


30 (1.96g, 5.84mmol) MeOH (58Ml) (58Ml) (1Ml)
 가 , 5 , , MeOH , .
 NaHCO₃ , , CHCl₃ , .
 , EtOAc , EtOAc , , 1.23g
 , 0.14g 가 , 81%
 가 $^1\text{H NMR}$ (DMSO- d_6) 3.54 - 3.55 (m, 2H), 4.49 - 4.51 (m, 2H), 7.36 - 7.41 (m, 1H), 7.
 82 (t, 1H, $J = 7.6$ Hz), 7.88 - 7.95 (m, 2H), 8.08 - 8.10 (m, 1H), 8.19 - 8.21 (m, 1H), 8.41 (s, 1H), 8.46 - 8.49 (
 m, 1H), 10.14 (s, 1H).



1 - (3 - -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (31a)
 : mp = 182 - 185 ; $R_f = 0.15$ (5% MeOH/CHCl₃)
 ; IR (KBr) 2361, 1653, 1458, 1091, 1046 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 3.31 (s, 6H), 3.52 - 3.54 (m, 2H), 4.
 45 - 4.46 (m, 2H), 5.50 (s, 1H), 7.36 (t, 1H, $J = 7.8$ Hz), 7.58 - 7.60 (m, 2H), 7.81 - 7.92 (m, 4H), 8.43 - 8.45 (
 m, 1H). HRMS calcd for C₁₉H₁₉N₃O₃ 337.1426 (M⁺), found 337.1415. Anal. (C₁₉H₁₉N₃O₃) C, H, N, O.

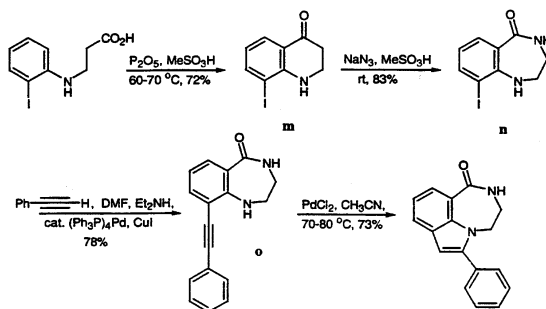
32: 1 - (3 -) - 8,9 - - 7HH - 2,7,9 aa - - [cdcd] - 6 -



3 - (6 - - 6,7,8,9 - - 2,7,9a - - [cd] - 1 -) - (가
 31 , 0.24g, 0.84mmol MeOH(40Mℓ) (MeOH
 2M , 3.60Mℓ, 7.2mmol) 가 , NaBH₃CN
 (0.061g, 0.092mmol) ZnCl₂ (0.063g, 0.46mmol) 가 . 2M HCl/MeOH(2.5Mℓ)
 pH 6 , 3 HCl(0.25Mℓ) 가 , MeO
 H₂O , 10% NaOH pH 10 - 11 CHCl₃
 3 , H₂O , (MgSO₄),
 (MeOH/CHCl₃)
 , 5% /CHCl₃ 0.20g(75%) 32 :
 mp= 192 - 194 (dec); R_f = 0.10(7% /CHCl₃); IR(KBr) 1651, 1464cm⁻¹; ¹H NMR(DMSO - d₆)
 2.19(s, 6H), 3.50(s, 2H), 3.52 - 3.53(m, 2H), 4.45 - 4.46(m, 2H), 7.33 - 7.38(m, 1H), 7.47 - 7.56(m,
 2H), 7.72 - 7.74(m, 1H), 7.78(s, 1H), 7.85 - 7.91(m, 2H), 8.44(t, 1H, J= 5.5 Hz). HRMS calcd for C₁₉H₂₁
 N₄O 321.1715(M⁺ H), found 321.1703. Anal.(C₁₉H₂₀N₄O · 0.5 H₂O) C, H, N.

1 - (3 - -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (32a)
 (0.013g, 5.5%): mp= 275 - 278 ; R_f = 0.26(10% MeOH/CHCl₃); IR(KBr) 1
 649, 1599, 1466, 1053cm⁻¹; ¹H NMR(DMSO - d₆) 3.46 - 3.53(m, 2H), 4.44 - 4.46(m, 2H), 4.61(d, 2H, J=
 5.7 Hz), 5.32 - 5.36(m, 1H), 7.33 - 7.38(m, 1H), 7.51 - 7.56(m, 2H), 7.70 - 7.72(m, 1H), 7.81(s, 1H), 7.85
 - 7.91(m, 2H), 8.43 - 8.47(m, 1H). HRMS calcd for C₁₇H₁₅N₃O₂ 293.1164(M⁺), found 293.1168. Anal.(C
 17H₁₅N₃O₂ · 0.5 H₂O) C, H, N.

33: 6 - - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



(a) m - 8 - - 2,3 - - 1H - - 4 - :

Bradley et al. (JCS PI, 2019(1972)) - 2 - , 3 -
 (2 -) - (0.103g, 0.354mmol) (Eaton's reagent) (2Mℓ)
 60 - 70 3 가 , 가 5
 0 % NaOH (pH 12) , EtOAc MgS
 O₄ , 0.070g(72%) , 가
¹H NMR(CDCl₃) 2.71(t, 2H, J= 6.0 Hz), 3.65(t, 2H, J= 6.0 Hz), 4.86(bs, 1H), 6.50(t, 1H, J= 9.0 Hz), 7.79(d, 1H, J= 9.0 Hz), 7.85(d, 1H, J= 9.0 Hz).

(b) n - 9 - - 1,2,3,4 - - [e][1,4] - 5 - :

CH₃SO₃H(50Mℓ) m(3.47g, 12.7mmol)
 NaN₃ (1.074g, 16.5mmol) 가 . 30
 (TLC), - 가 , 50 % NaOH (pH
 13), (3.05g, 83%) , : mp= 182 - 184 ; ¹H
 NMR(DMSO - d₆) 3.25 - 3.27(m, 2H), 3.48(bs, 2H), 5.43(bs, 1H), 6.41(t, 1H, J= 6.0 Hz), 7.73(d, 1H, J= 6.0 Hz), 7.80(d, 1H, J= 6.0 Hz), 8.15(bs, 1H). LRMS(M⁺) 288.

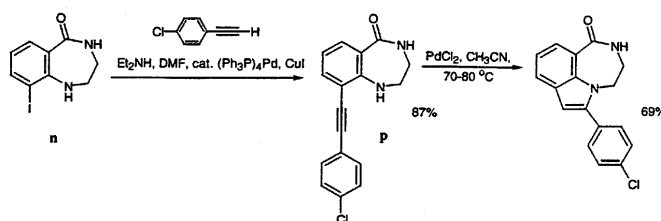
(c) o - 9 - - 1,2,3,4 - - [e][1,4] - 5 - :

n(0.144g, 0.005mmol), (0.055Mℓ, 0.5mmol), (O)(
 6mg, 0.005mmol), CuI(2mg, 0.01mmol), (4Mℓ) DMF(2Mℓ) 2
 , EtOAc , MgSO₄
 CHCl₃ 0 - 3% MeOH
 0.102g(78%) : IR(KBr) 3400, 31
 90, 3051, 1641, 1589, 1518, 1446, 1250, 756, 690cm⁻¹; ¹H NMR(DMSO - d₆) 3.27 - 3.29(m, 2H), 3.53 -
 3.56(m, 2H), 6.26(t, 1H, J= 6.0 Hz), 6.61(t, 1H, J= 6.0 Hz), 7.40 - 7.47(m, 4H), 7.62 - 7.65(m, 2H), 7.80
 (d, 1H, J= 6.0 Hz), 8.13(t, 1H, J= 6.0 Hz). LRMS(M⁺) 262.

(d) :

CH₃CN(10Mℓ) O(0.08g, 0.305mmol) PdCl₂ (0.003g, 0.0153mmol)
 가 . 70 - 80 3.5 가 . (TLC
), CHCl₃ 0 - 3% MeOH
 0.058g(73%) : ¹H NMR(DM
 SO - d₆) 3.46 - 3.51(m, 2H), 4.31 - 4.33(m, 2H), 6.71(s, 1H), 7.17(t, 1H, J= 9.0 Hz), 7.42 - 7.55(m, 3H),
 7.60 - 7.63(m, 2H), 7.78(d, 1H, J= 9.0 Hz), 7.82(d, 1H, J= 9.0 Hz), 8.38(t, 1H, J= 6.0 Hz). HRMS calcd fo
 r C₁₇H₁₄N₂O 262.1106(M⁺), found 262.1109. Anal. (C₁₇H₁₄N₂O · 0.1 H₂O) C, H, N.

34: 6 - (4 -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hih] - 1 -



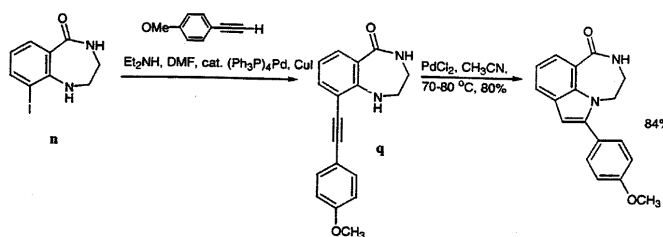
(a) p - 9 - (4 -) - 1,2,3,4 - - [e][1,4] - 5 - :

o , 1 - - 4 - 9 - - 1,2,3,4 -
 [e][1,4] - 5 - n p가 (87%): m
 p 178 - 180 ; ¹H NMR(DMSO - d₆) 3.27 - 3.30(m, 2H), 3.52 - 3.55(m, 2H), 6.31(t, 1H, J= 6.0 Hz), 6.61
 (t, 1H, J= 6.0 Hz), 7.45(d, 1H, J= 6.0 Hz), 7.50(d, 2H, J= 9.0 Hz), 7.67(d, 2H, J= 9.0 Hz), 7.82(d, 1H, J= 6.0 Hz), 8.13(t, 1H, J= 6.0 Hz). LRMS 296(M⁺).

(b) 6 - (4 -) - 3,4 - - 2H - [1,4] [6,7 - hi] - 1 - :

6 - - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (33)
 , p 69% : ¹H NMR(DM
 SO - d₆) 3.47 - 3.50(m, 2H), 4.29 - 4.32(m, 2H), 6.74(s, 1H), 7.18(t, 1H, J= 9.0 Hz), 7.58(d, 2H, J= 9.0
 Hz), 7.65(d, 2H, J= 9.0 Hz), 7.80(d, 2H, J= 9.0 Hz), 7.83(d, 2H, J= 9.0 Hz), 8.39(t, 1H, J= 4.5 Hz). HRMS
 calcd for C₁₇ H₁₃ N₂ OCl(M⁺) 296.0716, found 296.0715. Anal.(C₁₇ H₁₃ N₂ OCl) C, H, N.

35: 6 - (4 -) - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



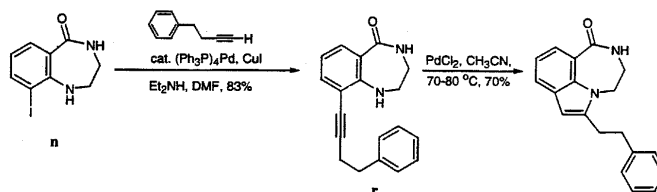
(a) q - 9 - (4 -) - 1,2,3,4 - - [e][1,4] - 5 - :

o , 1 - - 4 - 9 - - 1,2,3,4 -
 - [e] - 5 - n q가 80%
 : mp 193 - 195 ; ¹H NMR(DMSO - d₆) 3.27 - 3.29(m, 2H), 3.53 - 3.55(m, 2H), 3.81(s, 3H), 6.20(br s,
 1H), 6.60(t, 1H, J= 6.0 Hz), 6.98(d, 2H, J= 9.0 Hz), 7.41(d, 1H, J= 6.0 Hz), 7.57(d, 2H, J= 9.0 Hz), 7.79(
 d, 1H, J= 6.0 Hz), 8.11(t, 1H, J= 6.0 Hz). LRMS 292(M⁺).

(b) 6 - (4 -) - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - :

6 - - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (33)
 , q 84% : ¹H NMR(DMSO -
 d₆) 3.48 - 3.50(m, 2H), 4.27 - 4.30(m, 2H), 6.60(s, 1H), 7.07(d, 2H, J= 9.0 Hz), 7.15(t, 1H, J= 6.0 Hz),
 7.54(d, 2H, J= 9.0 Hz), 7.75(d, 1H, J= 6.0 Hz), 7.79(d, 1H, J= 6.0 Hz), 8.36(t, 1H, J= 6.0 Hz). HRMS calc
 d for C₁₈ H₁₆ N₂ O₂ (M⁺) 292.1212, found 292.1218. Anal.(C₁₈ H₁₆ N₂ O₂ · 0.1 H₂O) C, H, N.

36: 6 - - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



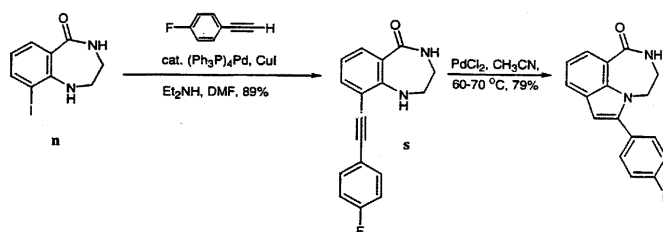
(a) $\text{r} - 9 - (4 -) - 1,2,3,4 - [e] [1,4] - 5 - :$

$\text{o} , 4 - - 1 - 9 - - 1,2,3,4 - [e] - 5 - \text{n} , \text{r} 83\%$
 : mp = 133 - 135 ; $^1\text{H NMR}(\text{DMSO} - d_6)$ 2.76 - 2.81(m, 2H), 2.86 - 2.90(m, 2H), 3.23 - 3.25(m, 2H), 3.39 - 3.41(m, 2H), 5.70(bs, 1H), 6.53(t, 1H, J= 6.0 Hz), 7.23(d, 1H, l= 6.0 Hz), 7.31 - 7.35(m, 5H), 7.69(d, 1H, J= 6.0 Hz), 8.07(t, 1H, J= 6.0 Hz); LRMS(M⁺) 290.

(b) 6 - - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - :

6 - - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (33)
 , $\text{r} , 70\% : ^1\text{H}$
 $\text{NMR}(\text{DMSO} - d_6)$ 2.96 - 3.06(m, 4H), 3.49 - 3.50(m, 2H), 4.21(bs, 2H), 6.37(s, 1H), 7.07(t, 1H, J= 6.0 Hz), 7.18 - 7.29(m, 5H), 7.65(d, 1H, J= 6.0 HZ), 7.74(d, 1H, J= 6.0 Hz), 8.26(t, 1H, J= 6.0 Hz); HRMS calcd. for C₁₉ H₁₈ N₂ O (M⁺) 290.1419, found 290.1421. Anal. (C₁₉ H₁₈ N₂ O) C, H, N.

37: 6 - (4 -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



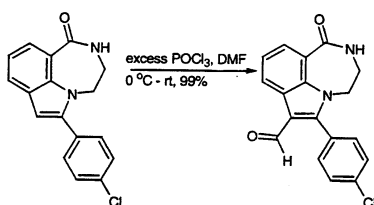
(a) $\text{s} - 9 - (4 -) - 1,2,3,4 - [e][1,4] - 5 - :$

$\text{o} , 1 - - 4 - 9 - - 1,2,3,4 - [e] - 5 - \text{n} , 89\%$
 : mp = 160 - 162 ; $^1\text{H NMR}(\text{DMSO} - d_6)$ 3.27 - 3.30(m, 2H), 3.52 - 3.55(m, 2H), 6.27(bs, 1H), 6.61(t, 1H, J= 6.0 Hz), 7.27(t, 2H, J= 9.0 Hz), 7.44(d, 1H, J= 6.0 Hz), 7.67 - 7.72(m, 2H), 7.80(d, 1H, J= 6.0 Hz), 8.13(t, 1H, J= 6.0 Hz). LRMS(M⁺) 280. Anal. (C₁₇ H₁₃ N₂ OF • 0.1 H₂O) C, H, N.

(b) :

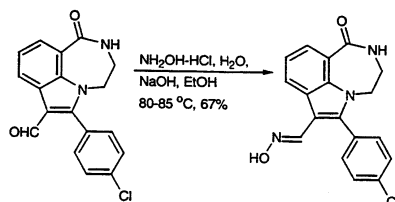
6 - - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (33)
 , $\text{s} , 79\%$
 $^1\text{H NMR}(\text{DMSO} - d_6)$ 3.48 - 3.50(m, 2H), 4.28 - 4.30(m, 2H), 6.70(s, 1H), 7.15(t, 1H, J= 6.0 Hz), 7.33 - 7.39(m, 2H), 7.65(d, 1H, J= 6.0 Hz), 7.68(d, 1H, J= 6.0 Hz), 7.78(d, 1H, J= 6.0 Hz), 7.82(d, 1H, J= 6.0 Hz), 8.38(t, 1H, J= 6.0 Hz). HRMS calcd. for C₁₇ H₁₃ N₂ OF (M⁺) 280.1012, found 280.1002. Anal. (C₁₇ H₁₃ N₂ OF) C, H, N.

38: 6 - (4 - -) - 1 - - 1,2,3,4 - - [1,4] - [6,7,1 - hihi] - - 7 -



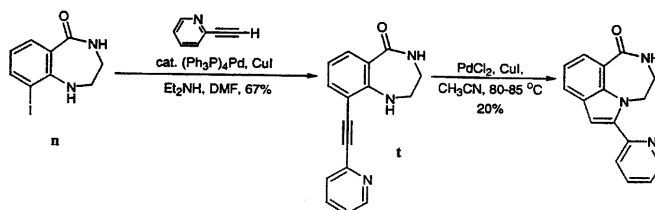
POCl₃ (0.3Mℓ, 3.19mmol) 0 DMF (3Mℓ) 가 . 15 , DMF(2Mℓ)
 6 - -3,4 - -2H - [1,4] [6,7,1 - hi] - 1 - (33, 0.070g, 0.236mmol)
 가 , 4 , H₂O
 , 50% NaOH (pH 12 - 14)
 0.077g(99%) : ¹H NMR(DMSO - d₆) 3.41 - 3.
 52(m, 2H), 4.20 - 4.22(m, 2H), 7.43(t, 1H, J= 9.0 Hz), 7.68(d, 2H, J= 9.0 Hz), 7.74(d, 2H, J= 9.0 Hz), 8.
 00(d, 1H, J= 6.0 Hz), 8.47(d, 1H, J= 6.0 Hz), 8.51(t, 1H, J= 6.0 Hz), 9.65(s, 1H). HRMS calcd. for C₁₈H₁₃N₂O₂Cl(M⁺) 324.0665, found 324.0668. Anal.(C₁₈H₁₃N₂O₂Cl · 0.25 H₂O) C, H, N.

39: 6 - (4 - -) - 1 - - 1,2,3,4 - - [6,7,1 - hihi] - - 7 -



EtOH(5Mℓ) H₂O(0.5Mℓ) 6 - (4 - -) - 1 - - 1,2,3,4 - - [1,4] -
 [6,7,1 - hi] - - 7 - (38, 0.050g, 0.154mmol) NH₂OH · HCl(0.027g, 0.385mmol)
 NaOH(0.016g, 0.385mmol) 가 . 80 - 85 3 가 , ,
 H₂O , CHCl₃ 0 - 5% MeOH
 , 0.035g(67%) : ¹H NMR(DMSO - d₆) 3.40(bs, 2H), 4.0 - 4.1(m, 2H), 7.30(t, 1H, J= 9.0
 Hz), 7.55(d, 2H, J= 9.0 Hz), 7.64(d, 2H, J= 9.0 Hz), 7.90(s, 1H), 7.94(d, 1H, J= 9.0 Hz), 8.34(d, 1H, J= 9.
 0 Hz), 8.41(t, 1H, J= 6.0 Hz), 10.83(s, 1H). HRMS calcd. for C₁₈H₁₄N₃O₂Cl(M⁺ + H) 340.0853, found 3
 40.0862. Anal. (C₁₈H₁₄N₃O₂Cl · 0.75 CH₂Cl₂) C, H, N.

40: 6 - - 2 - - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



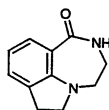
t - 9 - - 2 - - 1,2,3,4 - [e][1,4] - 5 - :

o , 2 - 9 - - 1,2,3,4 - -
 [e] - 5 - n , 67% t가 : mp=
 173 - 175 ; ¹H NMR(DMSO - d₆) 3.20 - 3.24(m, 2H), 3.54 - 3.56(m, 2H), 6.29(t, 1H, J= 6.0 Hz), 6.64(t, 1H, J= 6.0 Hz), 7.37 - 7.41(m, 1H), 7.50(d, 1H, J= 6.0 Hz), 7.77(d, 1H, J= 9.0 Hz), 7.82 - 7.88(m, 2H), 8.15(t, 1H, J= 6.0 Hz), 8.59(d, 1H, J= 6.0 Hz). LRMS(M⁺) 263.

(b) :

DMF(6Mℓ) t(0.050g, 0.190mmol) CuI(0.003g, 0.012mmol) PdCl₂(0.005g, 0.029mmol) 가 . 80 - 85 4 가 . (TLC), , CHCl₃ 0 - 3% MeOH 0.010g(20%) : ¹H NMR(DMSO - d₆) 3.38 - 3.55(m, 2H), 4.64(bs, 2H), 7.06(s, 1H), 7.19(t, 1H, J= 9.0 Hz), 7.37 - 7.41(m, 1H), 7.82 - 7.96(m, 4H), 8.38(t, 1H, J= 6.0 Hz), 8.70(d, 1H, J= 3.0 Hz). HRMS calcd. for C₁₆H₁₃N₃O(M⁺) 263.1059, found 263.1062. Anal.(C₁₆H₁₃N₃O · 0.8 H₂O) C, H, N.

41: 3,4,6,7 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -

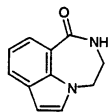


Hester et al.

(Hester et al., J.

Med. Chem.13, 827(1970)): ¹H NMR(DMSO - d₆) 2.92(t, 2H, J= 7.5 Hz), 3.29 - 3.31(m, 4H), 3.47(t, 2H, J= 7.5 Hz), 6.49(t, 1H, J= 7.5 Hz), 7.04(d, 1H, J= 7.5 Hz), 7.49(d, 1H, J= 7.5 Hz), 7.86(bs, 1H). HRMS calcd for C₁₁H₁₂N₂O(M⁺) 188.0950, found 188.0957. Anal.(C₁₁H₁₂N₂O) C, H, N.

42: 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



3,4,6,7 - - 2H - [1,4]

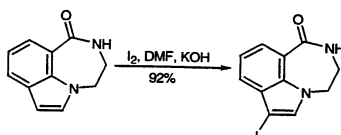
[6,7,1 - hi] - 1 - (41) , He

ster et al.

(Hester et al., J. Med. Chem.13, 8

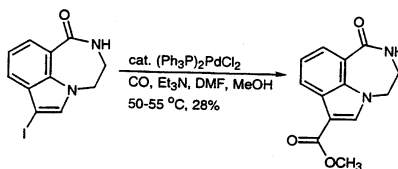
27(1970)): ¹H NMR(DMSO - d₆) 3.52 - 3.56(m, 2H), 4.31 - 4.36(m, 2H), 6.53(d, 1H, J= 3.0 Hz), 7.11(t, 1H, J= 6.0 Hz), 7.38(d, 1H, J= 3.0 Hz), 7.70(d, 1H, J= 6.0 Hz), 7.80(d, 1H, J= 6.0 Hz), 8.30(bs, 1H). LRM S(M⁺) 186. Anal. (C₁₁H₁₀N₂O · 0.05 H₂O) C, H, N.

43: 7 - - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



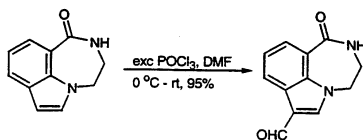
DMF 5Mℓ 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (42, 0.051g, 0.274mmol)
 , KOH(0.058g, 1.03mmol) (0.139g, 0.548mmol) 가 .
 EtOAc , 0.1%
 (sodium bisulfite) , H₂O MgSO₄ ,
 0.078g(92%) : ¹H NMR(DMSO - d₆) 3.56 - 3.59(m, 2H), 4.40(m, 2H), 7.
 26(t, 1H,J= 7.5 Hz), 7.52(d, 1H,J= 7.5 Hz), 7.67(s, 1H), 7.93(d, 1H,J= 7.5 Hz), 8.37(t, 1H,J= 5.3 Hz).
 HRMS calcd. for C₁₁ H₉ N₂ OI(M⁺) 311.9761, found 311.9776. Anal.(C₁₁ H₉ N₂ OI) C, H, N

44: 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hihi] - 7 -



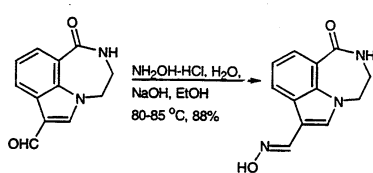
(0.11Mℓ, 0.747mol) , 8Mℓ MeOH 3Mℓ DMF 7 - - 3,4 - - 2H - [1,4]
 [6,7,1 - hi] - 1 - (43 , 0.074g, 0.37mmol)
 (8.4mg, 0.012mmol) 가 . CO , 50 - 55
 18 가 . EtOAc , M
 gSO₄ , CHCl₃ 0 - 3% MeOH
 0.025g(28%) : ¹H NMR(D
 MSO - d₆) 3.34 - 3.60(m, 2H), 3.83(s, 3H), 4.46(bs, 2H), 7.36(t, 1H,J= 7.5 Hz), 7.95(d, 1H,J= 7.5 Hz),
 8.23(s, 1H), 8.27(d, 1H,J= 7.5 Hz), 8.40 - 8.50(m, 1H). HRMS calcd. for C₁₃ H₁₂ N₂ O₃ (M⁺) 244.0848, f
 ound 244.0850. Anal.(C₁₃ H₁₂ N₂ O₃ • 0.25 H₂O) C, H, N.

45: 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hihi] - 7 -



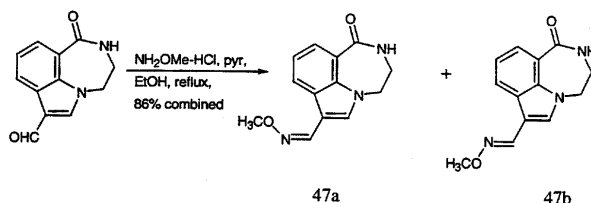
POCl₃ (16.37g, 106.76mmol) 0 DMF(225Mℓ) 가 . 15 , DMF
 (10Mℓ) 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (42, 1.46g, 7.85mmol)
 가 , 17 , H₂O
 , 50% NaOH (pH 12 - 14) , EtOAc .
 MgSO₄ , 1.6g(95%) : ¹H NMR(DMSO -
 d₆) 3.58 - 3.61(m, 2H), 4.48(bs, 2H), 7.37(t, 1H,J= 7.5 Hz), 7.97(d, 1H,J= 7.5 Hz), 8.33 - 8.35(m, 2H),
 8.43 - 8.45(m, 1H), 9.95(s, 1H). HRMS calcd. for C₁₂ H₁₀ N₂ O₂ (M⁺) 214.0742, found 214.0737. Anal.(C₁₂
 H₁₀ N₂ O₂ • 0.1H₂O) C, H, N.

46: 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hihi] - 7 -



EtOH(5Mℓ) H₂O(0.5Mℓ) 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hi]
 - 7 - (가 45 , 0.050g, 0.233mmol) , NH₂OH · HCl(0.
 041g, 0.583mmol) NaOH(0.024g, 0.583mmol) 가 . 80 - 85 2 가
 (0.047 g, 88%) : ¹H NMR(
 DMSO - d₆) 3.56(bs, 2H), 4.36(bs, 2H), 7.23(t, 1H, J= 7.5 Hz), 7.68(s, 1H), 7.90(d, 1H, J= 7.5 Hz), 8.
 21(d, 1H, J= 7.5 Hz), 8.26(s, 1H), 8.33 - 8.35(m, 1H), 10.66(s, 1H). HRMS calcd for C₁₂H₁₁N₃O₂ (M⁺)
 229.0851, found 229.0843. Anal.(C₁₂H₁₁N₃O₂) C, H, N.

47: (Z) (E) 1 - - 1,2,3,4 - - [1,4] [6, 7,1 - hihi] - 7 - O - -

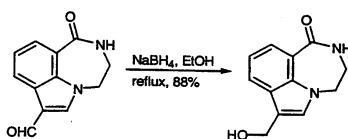


EtOH(5Mℓ) (5Mℓ) 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hi] - 7 -
 (45, 0.050g, 0.234mmol) MeONH₂ · HCl 20 ,
 H₂O , EtOAc MgSO₄
 CHCl₃ 0 - 1% MeOH
 , (E) 0.036g(63%) (Z) 0.013g(23%)

(Z) :¹H NMR(DMSO - d₆) 3.54 - 3.58(m, 2H), 3.96(s, 3H), 4.43(bs, 2H), 7.27(t, 1H, J= 9.0 Hz),
 7.89 - 7.92(m, 2H), 8.14(d, 1H, J= 9.0 Hz), 8.21(s, 1H), 8.35 - 8.39(m, 1H). HRMS calcd for C₁₃H₁₃N₃O₂
 (M⁺) 243.1008, found 243.1020. Anal.(C₁₃H₁₃N₃O₂ · 0.1 H₂O · 0.1 EtOAc) C, H, N.

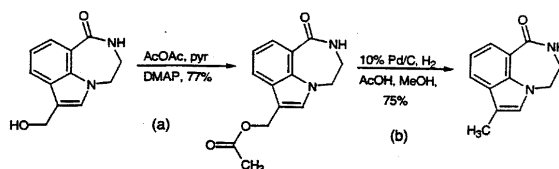
(E) :¹H NMR(DMSO - d₆) 3.55(bs, 2H), 3.87(s, 3H), 4.37(bs, 2H), 7.27(t, 1H, J= 7.5 Hz), 7.7
 5(s, 1H), 7.91(d, 1H, J= 7.5 Hz), 8.24(d, 1H, J= 7.5 Hz), 8.34 - 8.38(m, 2H). HRMS calcd. for C₁₃H₁₃N₃O₂
 (M⁺) 243.1008, found 243.1016. Anal.(C₁₃H₁₃N₃O₂ · 0.25 H₂O) C, H, N.

48: 7 - - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



(0.018g, 0.466mmol), EtOH 15Mℓ, 1 - - 1,2,3,4 - - [1,4]
 [6,7,1 - hi] - 7 - (45, 0.050g, 0.233mmol) 가 . 1.
 5 MgSO₄, 1% NaOH, EtOAc (88%) : ¹H NMR(DM
 SO - d₆) 3.52 - 3.55(m, 2H), 4.31(bs, 2H), 4.63(d, 2H, J= 5.0 Hz), 4.84(t, 1H, J= 5.0 Hz), 7.12(t, 1H, J
 = 7.5 Hz), 7.29(s, 1H), 7.80 - 7.83(m, 2H), 8.24 - 8.26(m, 1H). HRMS calcd for C₁₂H₁₂N₂O₂ (M⁺) 216.0
 899, found 216.0908. Anal.(C₁₂H₁₂N₂O₂ · 0.2H₂O) C, H, N.

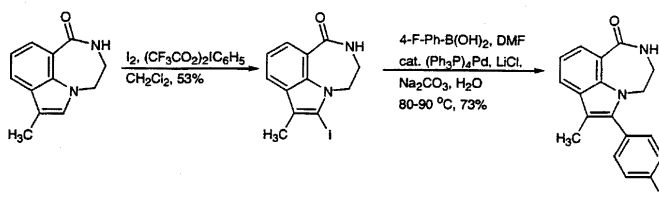
49: 7 - - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



(a) - 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hi] - 7 - :
 (1.1Mℓ, 11.65mmol) (25Mℓ) 7 - - 3,4 - - 2H - [1,4]
 [6,7,1 - hi] - 1 - (48, 1.007g, 11.65mmol) 4 - (0.057g, 0.466mmol)
 가 . 15 , CHCl₃ 0 - 3% Me
 OH 0.925g(77%)
 :¹H NMR(DMSO - d₆) 2.0(s, 3H), 3.42 - 3.44(bs, 2H), 4.23 - 4.25(bs, 2H), 5.30(s, 2H), 9.10(t, 1H, J=
 7.5 Hz), 7.50(s, 1H), 7.75(d, 1H, J= 7.5 Hz), 7.85(d, 1H, J= 7.5 Hz), 8.30(m, 1H).

(b) :
 - 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hi] - 7 - (0.508g, 1.97m
 mol) MeOH(70Mℓ) AcOH(30Mℓ) , 10% Pd/C(0.076g) 가 ,
 H₂ 4.5 ,
 CHCl₃ 0 - 1% MeOH ,
 0.296g(75%) :¹H NMR(DMSO - d₆) 2.52(s, 3H), 3.51 - 3.54(m, 2H), 4.27 - 4.28(m, 2H),
 7.11(t, 1H, J= 7.5 Hz), 7.15(s, 1H), 7.69(d, 1H, J= 7.5 Hz), 7.81(d, 1H, J= 7.5 Hz), 8.22 - 8.24(m, 1H). H
 RMS calcd. for C₁₂H₁₂N₂O(M⁺) 200.0950, found 200.0955. Anal.(C₁₂H₁₂N₂O) C, H, N.

50: 6 - (4 - -) - 7 - - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



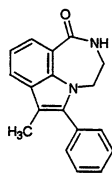
(a) 6 - 7 - 3,4 - 2H - [1,4] [6,7,1 - hi] - 1 - :

CH₂Cl₂ (5Mℓ) 7 - 3,4 - 2H - [1,4] [6,7,1 - hi] - 1 - (49, 0.030
g, 0.150mmol) (0.038g, 0.150mmol) (0.077g, 0.180mmol)
가 . 5 . CH₂Cl₂ , 10% Na₂S₂O₃
MgSO₄ , , . CHCl₃ 0 - 1%
MeOH 0.026g(53%)
: ¹H NMR(DMSO - d₆) 2.20(s, 3H), 3.33 - 3.35(bs, 2H), 4.32 - 4.35(bs, 2H), 7.10(t, 1H, J= 7.5 Hz), 7.
60(d, 1H, J= 7.5 Hz), 7.80(d, 1H, J= 7.5 Hz), 8.30(bs, 1H).

(b) :

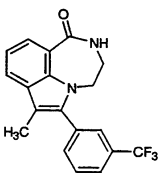
DMF(5Mℓ) 6 - 7 - 3,4 - 2H - [1,4] [6, 7,1 - hi] - 1 - (0.061g,
0.187mmol) , H₂O, LiCl(0.024g, 0.561 mmol) (0.011g, 0.009
4mmol) 4 - (0.029g, 0.206mmol), Na₂CO₃ (0.050g, 0.486mmol) 가 .
80 - 90 19 , H₂O , EtOAc
MgSO₄ , , .
CHCl₃ 0 - 1% MeOH ,
0.044g(73%) : ¹H NMR(DMSO - d₆) 2.77(s, 3H), 3.74(bs, 2H), 3.39 -
4.37(m, 2H), 7.45(t, 1H, J= 7.5 Hz), 7.63 - 7.67(m, 2H), 7.81 - 7.83(m, 2H), 8.04(d, 1H, J= 7.5 Hz), 8.12
(d, 1H, J= 7.5 Hz), 8.57 - 8.59(m, 1H). HRMS calcd for C₁₈H₁₅N₂OF(M⁺) 294.1168, found 294.1175. An
al.(C₁₈H₁₅N₂OF • 0.1 H₂O) C, H, N.

51: 6 - 7 - 3,4 - 2HH - [1,4] [6,7,1 - hihi] - 1 -



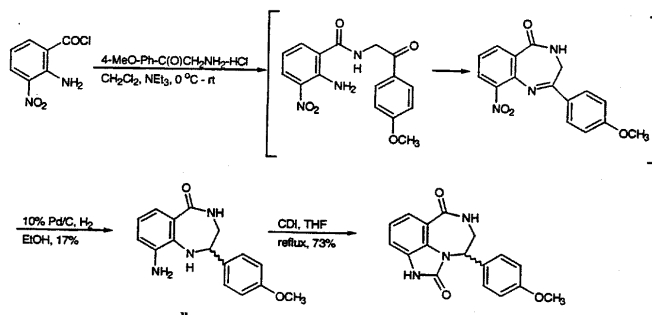
50(b) , 6 - 7 - 3,4 - 2H - [1,4] [6,7,1 - hi]
- 1 - (50(a) , 70%)
: ¹H NMR(DMSO - d₆) 2.23(s, 3H), 3.46(bs, 2H), 4.13(bs, 2H), 7.17(t, 1H, J= 7.5 Hz), 7.45 - 7.56(
m, 5H), 7.76(d, 1H, J= 7.5 Hz), 7.84(d, 1H, J= 7.5 Hz), 8.29 - 8.31(m, 1H). LRMS(M⁺) 276. Anal.(C₁₈H₁₅
N₂O • 0.4 H₂O) C, H, N.

52: 6 - (3 -) - 7 - 3,4 - 2HH - [1,4] [6,7,1 - hihi] -
1 -



50(b) , 6 - - 7 - - 3,4 - - 2H - [1,4] [6,7,1 - hi]
 - 1 - (50(a)) 3 - , HPLC
 81% . 2 90% 0.1%M NH₄ OAc, 10% CH₃ CN , 22
 100% CH₃ CN (gradient mobile phase) (R_f = 17.59min).
¹H NMR(DMSO - d₆) 2.25(s, 3H), 3.44 - 3.48(m, 2H), 4.13 - 4.16(m,
 2H), 7.19(t, 1H,J= 7.5 Hz), 7.77 - 7.88(m, 6H), 8.32 - 8.36(m, 1H). HRMS calcd. for C₁₉ H₁₅ N₂ O₃ (M⁺)
 344.136, found 344.1136. Anal. HPLC R_t = 14.9 min.

53: (RS) - (±) - 9 - (4 - -) - 8,9 - - 2 HH,7HH - 2,7,9a - - [cdcd]
 - 1,6 -



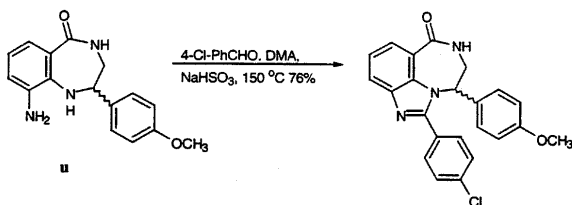
(a) u - (RS) - (±) - 9 - - 2 - (4 - -) - 1,2,3,4 - - [e][1,4]
 - 5 - :

Breslin et al., J. Med. Chem. (1995), 38: 771 - 792 . 505mg 2 -
 - 3 - (2.77mmol) , 558mg 2 - - 4' -
 (2.77mmol) 715Mℓ Et₃N(5.54mmol) 0 CH₂Cl₂ , 가
 , CH₂Cl₂ , NaHCO₃ , 1N HCl . (MgSO₄),
 , 10% Pd/C 500mg EtOH 150Mℓ
 , 60psi H₂ 48 가 (hydrogenation) . 24
 , 가 10% Pd/C 가 , Celite ,
 . (40 - 50% CH₃ CN/CH₂ Cl₂) ,
 140mg(17%) : ¹H NMR(CDCl₃) 3.35(bs, 2H), 3.49 - 3.54(m, 2H), 3.80(s, 3H),
 4.15(bs, 1H), 4.70 - 4.75(m, 1H), 6.58(bt, 1H,J= 6.0 Hz), 6.81(t, 1H,J= 7.8 Hz), 6.85 - 6.93(m, 3H), 7.2
 4 - 7.30(m, 2H), 7.44(dd, 1H,J= 1.7, 7.8 Hz).

(b) :

THF 3Mℓ 35mg u(0.12mmol) 40mg 6
 , (2.5 - 5% MeOH/CH₂ Cl₂)
 , 27mg(73%) : IR(KBr) 3261, 2927, 1
 706, 1648, 1624, 1514, 1473, 1386, 1339, 1296, 1249, 1178, 1111, 1045, 1030, 756cm⁻¹; ¹H NMR(DMSO
 - d₆) 3.67 - 3.78(m, 1H), 3.74(s, 3H), 3.87 - 3.98(m, 1H), 5.68(d, 1H,J= 3.7 Hz), 6.13 - 6.18(m, 1H),
 6.83(d, 2H,J= 8.7 Hz), 7.03(d, 2H,J= 8.7 Hz), 7.18 - 7.29(m, 2H), 7.88(dd, 1H,J= 1.4, 7.8 Hz), 9.37(bs,
 1H). LRMS calcd for C₁₇ H₁₅ N₃ O₃ +H 310, found 310.

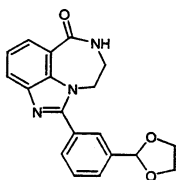
54: (RS) - (±) - 1 - (4 -) - 9 - (4 -) - 8,9 - - HH - 2,7,9a - -
[cdcd] - 6 -



(Higgins et al., J. Polym. Sci. Part A - 1 (1970), 8: 171 - 177; Imai et al., Synthesis (1981), 35 - 36)

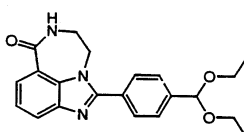
, 3M DMA 92mg u(0.32mmol), 54mg 4- (0.38mmol) 48mg
(0.46mmol) 150 10 가 .
200M 가 . 98
mg(76%) . IR(KBr) 3206, 3094, 2836, 1651, 1689, 1596, 1513, 1474, 1441, 1403, 1370, 1252, 1178, 1092, 1032, 1015, 1002, 843, 817, 755cm⁻¹; ¹H NMR(DMSO - d₆) 3.70 - 3.76(m, 1H), 3.80(s, 3H), 3.92 - 3.99(m, 1H), 5.64(d, 1H, J= 4.3 Hz), 6.01 - 6.06(m, 1H), 6.87 - 7.00(m, 4H), 7.32 - 7.55(m, 5H), 8.09(d, 1H, J= 1.0, 8.0 Hz), 8.16(d, 1H, J= 1.0, 7.8 Hz); ¹³C NMR(DMSO - d₆) 46.90, 55.41, 61.82, 114.99, 116.92, 123.16, 124.52, 127.17, 127.42, 127.52, 129.03, 130.58, 131.01, 132.61, 137.00, 143.27, 153.62, 159.70, 168.76. LRMS calcd for ²³H₁₈ClN₃O₂ (M+H) 404, found 404. Anal.(C₂₃H₁₈ClN₃O₂ · 0.2 H₂O) C, H, N, Cl.

55: (3 - [1,3]) - 2 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



, CH₂Cl₂ 19 CH₂Cl₂
g 3 - [1,3] - 2 - - (Marx et al., Liebig's Annalen der Chemie 3. (1992), 183)
3.10g(91%) : mp= 223 - 225 ; R_f = 0.23(5% MeOH/EtO
Ac); IR(KBr) 2361, 1653, 1635 1458cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.53(m, 2H), 3.96 - 4.12(m, 4H), 4.45 - 4.46(m, 2H), 5.85(s, 1H), 7.36(t, 1H, J= 7.8 Hz), 7.58 - 7.65(m, 2H), 7.86 - 7.93(m, 4H), 8.45(m, 1H). HRMS calcd for C₁₉H₁₇N₃O₃ 335.1270(M⁺), found 335.1278. Anal.(C₁₉H₁₇N₃O₃) C, H, N.

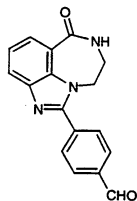
56: 1 - (4 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



55

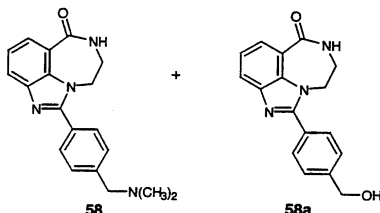
1.19g(77%) : mp= 213 - 215 ; $R_f = 0.21$ (90% EtOAc/); IR(KBr) 1660, 1605, 1481, 1307, 1055 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 1.18(t, 6H, J= 7.0 Hz), 3.48 - 3.63(m, 6H), 4.45 - 4.47(m, 2H), 5.59(s, 1H), 7.36(t, 1H, J= 7.8 Hz), 7.59(d, 2H, J= 8.2 Hz), 7.85 - 7.92(m, 4H), 8.45(t, 1H, J= 5.7 Hz). HRMS calcd for $\text{C}_{21}\text{H}_{23}\text{N}_3\text{O}_3$ 365.1739(M^+), found 365.1749. Anal.($\text{C}_{21}\text{H}_{23}\text{N}_3\text{O}_3$) C, H, N

57: 4 - (6 - - 6,7,8,9 - - 2,7,9 aa - - [cdcd] - 1 -) -



1 - (3 - -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (0.79g, 2.18mmol)
EtOH(22Ml) (22Ml) , EtOH (0.5Ml) 가 , 5
NaHCO₃ ,
0.47g(74%) : ^1H
NMR(DMSO- d_6) 3.54 - 3.55(m, 2H), 4.50 - 4.51(m, 2H), 7.39(t, 1H, J= 7.8 Hz), 7.88 - 7.96(m, 2H), 8.09 - 8.10(m, 4H), 8.46 - 8.50(m, 1H), 10.13(s, 1H).

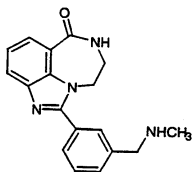
58: 1 - (4 - -) - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6 -



32 , 4 - (6 - - 6,7,8,9 - - 2,7,9a - - [cd] - 1
-) - 0.37g(71%) 1 - (4 - -) - 8,9 - - 7H - 2,7,9a -
- [cd] - 6 - (58) : mp= 227 - 230 ; $R_f = 0.16$ (7% /CHC
l₃); IR(KBr) 1663, 1603, 1478, 1308 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 2.19(s, 6H), 3.49(s, 2H), 3.52 - 3.53(m, 2H), 4.45 - 4.47(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.49(d, 2H, J= 8.2 Hz), 7.81 - 7.90(m, 4H), 8.43 - 8.47(m, 1H). HRMS calcd for $\text{C}_{19}\text{H}_{20}\text{N}_4\text{O}$ 320.1637(M^+), found 320.1639. Anal.($\text{C}_{19}\text{H}_{20}\text{N}_4\text{O}$) C, H, N.

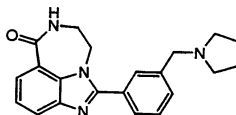
32 , 1 - (4 - -) - 8,9 - - 7H - 2,7,9a - - [cd
] - 6 - , 0.33g(19%) 1 - (4 - -) - 8,9 - - 7H - 2,7,9
a - - [cd] - 6 - (58a) : mp= 262 - 264 ; $R_f = 0.32$ (10% MeOH/CHC
l₃); IR(KBr) 1651, 1470, 1310 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 3.52 - 3.53(m, 2H), 4.44 - 4.46(m, 2H), 4.60(d, 2H, J= 5.7 Hz), 5.33 - 5.37(m, 1H), 7.35(t, 1H, J= 7.8 Hz), 7.51(d, 2H, J= 8.2 Hz), 7.82(d, 2H, J= 8.2 Hz), 7.84 - 7.91(m, 2H), 8.45(t, 1H, J= 5.7 Hz). HRMS calcd for $\text{C}_{17}\text{H}_{15}\text{N}_3\text{O}_2$ 293.1164(M^+), found 293.1153. Anal.($\text{C}_{17}\text{H}_{15}\text{N}_3\text{O}_2$) C, H, N.

59: 1 - (3 -) -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



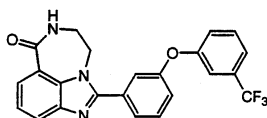
32 , 3 - (6 - - 6,7,8,9 - - 2,7,9a - - [cd] - 1
 -) - 0.12g(23%) 1 - (3 - -) - 8,9 - - 7H - 2,7,9
 a - [cd] - 6 - : mp= 110 (dec); R_f = 0.08(10%
 /CHCl₃); IR(KBr) 1655, 1464, 1381, 1308cm⁻¹; ¹H NMR(DMSO - d₆) 2.31(s, 3H), 3.52 - 3.53
 (m, 2H), 3.79(s, 2H), 4.45 - 4.47(m, 2H), 7.36(t, 1H, J= 7.8 Hz), 7.52 - 7.53(m, 2H), 7.71 - 7.75(m, 1H),
 7.83 - 7.91(m, 3H), 8.46(t, 1H, J= 5.7 Hz). HRMS calcd for C₁₈ H₁₇ N₄ O 305.1402(M - H)⁺, found 305.14
 16. Anal.(C₁₈ H₁₈ N₄ O • 0.75 H₂O) C, H, N.

60: 1 - (3 - - 1 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



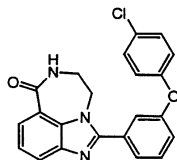
32 , 3 - (6 - - 6,7,8,9 - - 2,7,9a - - [cd] - 1
 -) - 0.46g(78%) 1 - (3 - - 1 - -) - 8,9 - - 7H -
 2,7,9a - - [cd] - 6 - : mp= 92 (dec); R_f =
 0.21(10% /CHCl₃); IR(KBr) 1659, 1464, 1379, 1308cm⁻¹; ¹H NMR(DMSO - d₆) 1.69 - 1.7
 1(m, 4H), 2.47 - 2.50(m, 4H), 3.52 - 3.53(m, 2H), 3.68(s, 2H), 4.45 - 4.46(m, 2H), 7.35(t, 1H, J= 7.8 Hz),
 7.48 - 7.55(m, 2H), 7.70 - 7.73(m, 1H), 7.79(s, 1H), 7.85 - 7.91(m, 2H), 8.42 - 8.46(m, 1H). HRMS calcd
 for C₂₁ H₂₁ N₄ O 345.1715(M - H)⁺, found 345.1719. Anal.(C₂₁ H₂₂ N₄ O • 0.2 H₂O) C, H, N.

61: 1 - [3 - (3 - -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



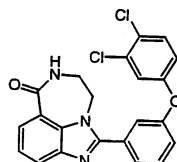
55, 3 - [3 - ()] 0.089g(48%)
 : mp= 121 - 122 ; R_f = 0.21(90% EtOAc/); IR(KBr) 1661, 1580, 1445, 1327, 1126cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.53(m, 2H), 4.46 - 4.48(m, 2H), 7.29 - 7.44(m, 4H), 7.53 - 7.56(m, 2H), 7.61 - 7.71(m, 3H), 7.85 - 7.91(m, 2H), 8.45(t, 1H, J= 5.6 Hz). HRMS calcd for C₂₃H₁₇N₃O₂F₃ 424.1273(M+H), found 424.1277. Anal.(C₂₃H₁₆N₃O₂F₃ · 1.0₂O) C, H, N.

62: 1 - [3 - (4 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



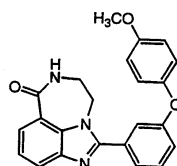
55, 3 - (4 -) 0.114g(66%)
 : mp= 211 - 212 ; R_f = 0.16(75% EtOAc/); IR(KBr) 1659, 1578, 1483, 1462, 1233cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.53(m, 2H), 4.45 - 4.46(m, 2H), 7.11 - 7.17(m, 2H), 7.22 - 7.26(m, 1H), 7.35(t, 1H, J= 7.8 Hz), 7.45 - 7.50(m, 3H), 7.58 - 7.66(m, 2H), 7.85 - 7.91(m, 2H), 8.43 - 8.47(m, 1H). HRMS calcd for C₂₂H₁₆N₃O₂Cl 389.0931(M⁺), found 389.0948. Anal.(C₂₂H₁₆N₃O₂Cl · 0.25 H₂O) C, H, N.

63: 1 - [3 - (3,4 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



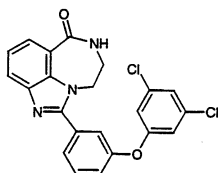
55, 3 - (3,4 -) 0.084g(45%)
 : mp= 252 - 254 (dec); R_f = 0.13(75% EtOAc/); IR(KBr) 1657, 1578, 1468, 1263cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.53(m, 2H), 4.45 - 4.47(m, 2H), 7.11(dd, 1H, J= 8.9, 2.8 Hz), 7.28 - 7.32(m, 1H), 7.36(t, 1H, J= 7.8 Hz), 7.43(d, 1H, J= 2.8 Hz), 7.54 - 7.55(m, 1H), 7.60 - 7.71(m, 3H), 7.85 - 7.91(m, 2H), 8.43 - 8.47(m, 1H). HRMS calcd for C₂₂H₁₅N₃O₂Cl₂ 423.0541(M⁺), found 423.0538. Anal.(C₂₂H₁₅N₃O₂Cl₂ · 0.3 H₂O) C, H, N.

64: 1 - [3 - (4 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



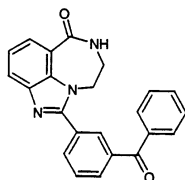
55, 3 - (4 -) 0.13g(84%)
 : mp= 196 - 198 ; R_f = 0.21(90% EtOAc/); IR(KBr) 1660, 1505, 1462, 1215cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.53(m, 2H), 3.76(s, 3H), 4.43 - 4.46(m, 2H), 7.00(d, 2H, J= 9.2 Hz), 7.10(d, 2H, J= 9.2 Hz), 7.07 - 7.15(m, 1H), 7.32 - 7.37(m, 2H), 7.52 - 7.58(m, 2H), 7.84 - 7.89(m, 2H), 8.43 - 8.46(m, 1H). HRMS calcd for C₂₃H₁₉N₃O₃ 385.1341(M⁺), found 385.1442. Anal.(C₂₃H₁₉N₃O₃ · 0.4 H₂O) C, H, N.

65: 1 - [3 - (3,5 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6



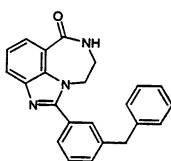
55, 3 - (3,5 -) 0.14g(86%)
 : mp= 258 - 259 (dec); R_f = 0.13(75% EtOAc/); IR(KBr) 1663, 1576, 1431, 1250cm⁻¹; ¹H NMR(DMSO - d₆) 3.53 - 3.54(m, 2H), 4.47 - 4.49(m, 2H), 7.18(d, 2H, J= 1.8 Hz), 7.31 - 7.42(m, 3H), 7.58 - 7.74(m, 3H), 7.86 - 7.92(m, 2H), 8.46(m, 1H). HRMS calcd for C₂₂H₁₅N₃O₂Cl₂ 423.0541(M⁺), found 423.0549. Anal.(C₂₂H₁₅N₃O₂Cl₂ · 0.2 H₂O) C, H, N.

66: 1 - (3 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



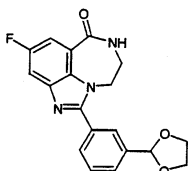
2, 3 - (Ito et al., J. Org. Chem. (1985), 50: 2893)
 72, CH₂Cl₂ 0.12g(65%)
 : mp= 237 - 238 (dec); R_f = 0.13(90% EtOAc/); IR(KBr) 1659, 1464, 1312cm⁻¹; ¹H NMR(DMSO - d₆) 3.53 - 3.55(m, 2H), 4.48 - 4.49(m, 2H), 7.37(t, 1H, J= 7.8 Hz), 7.57 - 7.62(m, 2H), 7.69 - 7.94(m, 7H), 8.15 - 8.18(m, 2H), 8.46(t, 1H, J= 5.6 Hz). HRMS calcd for C₂₃H₁₇N₃O₂ 367.1321(M⁺), found 367.1306. Anal.(C₂₃H₁₇N₃O₂) C, H, N.

67: 1 - (3 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



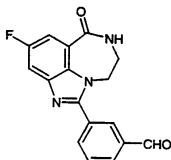
2, 3 - (Norris and Ware, J. Amer. Chem. Soc. (1939), 61
: 1418) 72, CH₂Cl₂
0.13g (68%) : mp = 205 - 208 ; R_f = 0.18 (75% EtOAc/); IR (KBr) 1655,
1464, 1381, 1310 cm⁻¹; ¹H NMR (DMSO - d₆) 3.50 - 3.51 (m, 2H), 4.06 (s, 2H), 4.43 - 4.44 (m, 2H), 7.16 -
7.22 (m, 1H), 7.26 - 7.37 (m, 5H), 7.43 - 7.52 (m, 2H), 7.66 - 7.68 (m, 1H), 7.74 - 7.75 (m, 1H), 7.84 - 7.90 (m,
2H), 8.44 (t, 1H, J = 5.6 Hz). HRMS calcd for C₂₃H₁₉N₃O 353.1528 (M⁺), found 353.1527. Anal. (C₂₃H₁₉
N₃O · 0.25 H₂O) C, H, N.

68: 1 - (3 - [1,3] - 2 - -) - 4 - - 8,9 - - 7 HH - 2,7,9a - - [cd
cd] - 6 -



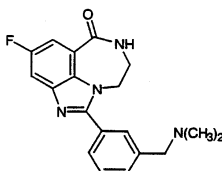
55, g I (18), 0.60g (54%)
: mp = 262 - 264 (dec); R_f = 0.11 (90% EtOAc/); IR (KBr) 1667, 1487, 1460,
1389 cm⁻¹; ¹H NMR (DMSO - d₆) 3.54 - 3.55 (m, 2H), 3.96 - 4.12 (m, 4H), 4.45 - 4.46 (m, 2H), 5.85 (s, 1H),
7.58 - 7.66 (m, 3H), 7.75 - 7.79 (m, 1H), 7.85 - 7.88 (m, 1H), 7.92 (s, 1H), 8.59 - 8.63 (m, 1H). HRMS calcd
for C₁₉H₁₆N₃O₃F 353.1176 (M⁺), found 353.1183. Anal. (C₁₉H₁₆N₃O₃F · 0.25 H₂O) C, H, N.

69: 3 - (4 - - 6 - - 6,7,8,9 - - 2,7,9a - - [cdcd] - 1 -) -



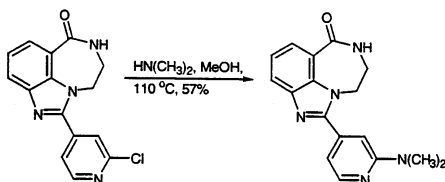
31 (deprotection), 0.43g (89%) 3 - (4 - - 6 - - 6,7,8,9 -
- 2,7,9a - - [cd] - 1 -) - 가 ¹H NMR (D
MSO - d₆) 3.56 - 3.58 (m, 2H), 4.50 - 4.51 (m, 2H), 7.61 - 7.65 (m, 1H), 7.78 - 7.85 (m, 2H), 8.09 - 8.11 (m,
1H), 8.17 - 8.21 (m, 1H), 8.39 - 8.40 (m, 1H), 8.64 (t, 1H, J = 5.6 Hz), 10.14 (s, 1H).

70: 1 - (3 - -) - 4 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
- 6 -



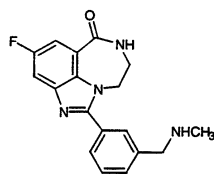
32, 3 - (4 - 6 - 6,7,8,9 - 2,7,9a -
 - [cd] - 1 -) - 0.067g(31%) 1 - (3 -) - 4 -
 - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - : mp = 215 - 217
 (dec); $R_f = 0.11(7\%)$ /CHCl₃); IR(KBr) 1663, 1485, 1383cm⁻¹; ¹H NMR(DMSO - d₆) 2.1
 9(s, 6H), 3.50(s, 2H), 3.54 - 3.55(m, 2H), 4.45 - 4.47(m, 2H), 7.48 - 7.62(m, 3H), 7.72 - 7.78(m, 3H), 8.6
 1(t, 1H, J = 5.7 Hz). HRMS calcd for C₁₉H₁₈N₄O 337.1465(M - H), found 337.1464. Anal.(C₁₉H₁₉N₄O ·
 0.25₂O) C, H, N.

71: 1 - (2 - - 4 -) - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6



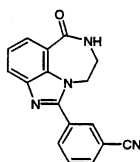
15 (0.087g, 0.29mmol), 가 EtOH(4Mℓ)
 (2M/MeOH, 4.37Mℓ, 8.75mmol) 가, , 110 6 가
 (2Mℓ) 가, 110
 (0 - 5% MeOH/EtOAc) 0.051g(57%) : mp = 26
 6 - 268 ; $R_f = 0.16(5\% \text{ MeOH/EtOAc})$; IR(KBr) 1657, 1611, 1510cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.53
 (m, 2H), 4.49 - 4.50(m, 2H), 6.96 - 6.99(m, 2H), 7.38(t, 1H, J = 7.8 Hz), 7.89(dd, 1H, J = 1.0, 7.7 Hz), 7.9
 3(dd, 1H, J = 1.0, 8.0 Hz), 8.26(d, 1H, J = 5.1 Hz), 8.47(t, 1H, J = 5.6 Hz). HRMS calcd for C₁₇H₁₇N₅O 307.1433(M⁺), found 307.1431. Anal.(C₁₇H₁₇N₅O) C, H, N.

72: 1 - (3 - -) - 4 - - 8,9 - - 7HH - 2,7,9a - - [cdcd]
 - 6 -



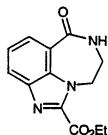
32 (2M/MeOH) 3 - (4 - 6 - 6,7,8,9 -
 - 2,7,9a - - [cd] - 1 -) - 1 - (3 - -) - 4 -
 - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - 0.037g(18%) :
 mp = 196 - 198 ; $R_f = 0.03(7\%)$ /CHCl₃); IR(KBr) 1655, 1487, 1466, 1134cm⁻¹; ¹H NMR(DM
 SO - d₆) 2.29(s, 3H), 3.54 - 3.57(m, 2H), 3.74(s, 2H), 4.45 - 4.47(m, 2H), 7.51 - 7.53(m, 2H), 7.57 - 7.
 62(m, 1H), 7.68 - 7.77(m, 2H), 7.80(s, 1H), 8.62(t, 1H, J = 5.6 Hz). HRMS calcd for C₁₈H₁₇N₄O 323.1308(M⁺), found 323.1305. Anal.(C₁₈H₁₇N₄O · 0.3 H₂O) C, H, N.

73: 3 - (6 - 6,7,8,9 - 2,7,9a - - [cdcd] - 1 -) -



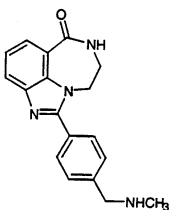
55, 3- , 0.143g(30%)
 : mp= 283 - 284 (dec); $R_f = 0.13$ (90% EtOAc/); IR(KBr) 2233, 1659, 1462 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 3.53 - 3.54(m, 2H), 4.47 - 4.49(m, 2H), 7.39(t, 1H, $J = 7.8$ Hz), 6.66 - 7.83(m, 1H), 7.89 - 7.95(m, 2H), 8.04 - 8.06(m, 1H), 8.19 - 8.22(m, 1H), 8.31 - 8.32(m, 1H), 8.46 - 8.50(m, 1H). HRMS calcd for $\text{C}_{17}\text{H}_{12}\text{N}_4\text{O}$ 288.1011(M^+), found 288.1002. Anal. ($\text{C}_{17}\text{H}_{12}\text{N}_4\text{O} \cdot 0.5\text{H}_2\text{O}$) C, H, N.

74: 6 - - 6,7,8,9 - - 2,7,9a - - [cdcd] - 1 -



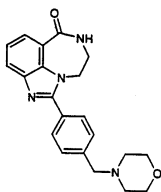
55, (50%)
 , 0.086g(28%) : mp= 237 - 239 (dec); $R_f = 0.20$ (5% MeOH/ CHCl_3); IR(KBr) 1719, 1663, 1655 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 1.36(t, 3H, $J = 7.1$ Hz), 3.35 - 3.36(m, 2H), 3.58 - 3.60(m, 2H), 4.39(q, 2H, $J = 7.1$ Hz), 7.45(t, 1H, $J = 7.8$ Hz), 7.99 - 8.04(m, 2H), 8.47 - 8.50(m, 1H). HRMS calcd for $\text{C}_{13}\text{H}_{13}\text{N}_3\text{O}_3$ 259.0957(M^+), found 259.0965. Anal. ($\text{C}_{13}\text{H}_{13}\text{N}_3\text{O}_3 \cdot 0.1\text{H}_2\text{O}$) C, H, N.

75: 1 - (4 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



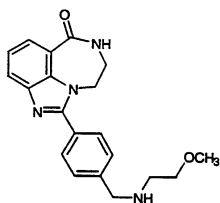
32, (2M/MeOH) 4 - (6 - - 6,7,8,9 -
 - 2,7,9a - - [cd] - 1 -) - 1 - (4 - -) - 8,9 - - 7
 H - 2,7,9a - - [cd] - 6 - 0.44g(53%) : mp= 169 - 172 ; $R_f = 0.0$
 8(10% / CHCl_3); IR(KBr) 1651, 1480, 1308 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 2.30(s, 3H), 3.52 - 3.53(m, 2H), 3.75(s, 2H), 4.45 - 4.46(m, 2H), 7.35(t, 1H, $J = 7.8$ Hz), 7.52(d, 2H, $J = 8.1$ Hz), 7.81(d, 2H, $J = 8.1$ Hz), 7.84 - 7.90(m, 2H), 8.43 - 8.47(m, 1H). HRMS calcd for $\text{C}_{18}\text{H}_{18}\text{N}_4\text{O}$ 306.1480(M^+), found 306.1486. Anal. ($\text{C}_{18}\text{H}_{18}\text{N}_4\text{O} \cdot 0.5\text{H}_2\text{O}$) C, H, N.

76: 1 - (4 - - 4 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



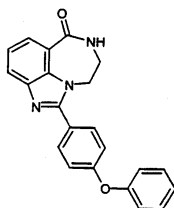
32 , 4 - (6 - - 6,7,8,9 - - 2,7,9a -
- [cd] - 1 -) - 1 - (4 - - 4 - -) - 8,9 - - 7H - 2,7,
9a - - [cd] - 6 - 0.097g(38%) : mp= 285 - 286 (dec); $R_f = 0.11$
(5% MeOH/CHCl₃); IR(KBr) 1661, 1653, 1483, 1113cm⁻¹; ¹H NMR(DMSO - d₆) 2.40 - 2.41(m, 4H), 3.1
5 - 3.17(m, 2H), 3.26 - 3.61(m, 6H), 4.45 - 4.46(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.51(d, 2H, J= 8.1 Hz), 7.
82(d, 2H, J= 8.1 Hz), 7.84 - 7.90(m, 2H), 8.43 - 8.47(m, 1H). HRMS calcd for C₂₁ H₂₂ N₄ O₂ 362.1743(M⁺),
found 362.1737. Anal.(C₂₁ H₂₂ N₄ O₂) C, H, N.

77: 1 - (4 - [(2 -)] -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
- 6 -



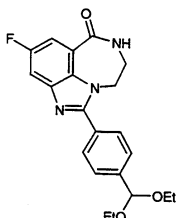
32 , 2 - 4 - (6 - - 6,7,8,9 - - 2,
7,9a - - [cd] - 1 -) - 0.091g(38%) : m
p= 154 - 157 ; $R_f = 0.11$ (10% MeOH/CHCl₃); IR(KBr) 1659, 1483, 1088cm⁻¹; ¹H NMR(DMSO - d₆) 2.6
7(t, 2H, J= 5.7 Hz), 3.24(s, 3H), 3.42(t, 2H, J= 5.7 Hz), 3.52 - 3.53(m, 2H), 3.81(s, 2H), 4.45 - 4.46(m,
2H), 7.35(t, 1H, J= 7.8 Hz), 7.52(d, 2H, J= 8.1 Hz), 7.80(d, 2H, J= 8.1 Hz), 7.84 - 7.90(m, 2H), 8.43 - 8.4
6(m, 1H). HRMS calcd for C₂₀ H₂₂ N₄ O₂ 350.1743(M⁺), found 350.1756. Anal.(C₂₀ H₂₂ N₄ O₂) C, H, N.

78: 1 - (4 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



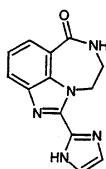
55, 4- 0.13g(67%)
 : mp= 259 - 264 ; IR(KBr) 1664, 1591, 1480 1236cm⁻¹; ¹H NMR(DMSO - d₆) 3.53 - 3.54(m, 2 H), 4.45 - 4.46(m, 2H), 7.12 - 7.16(m, 4H), 7.20 - 7.25(m, 1H), 7.32 - 7.37(m, 1H), 7.44 - 7.49(m, 2H), 7.84 - 7.89(m, 4H), 8.43 - 8.46(m, 1H). HRMS calcd for C₂₂H₁₇N₃O₂ 355.1321(M⁺), found 355.1321. Anal. (C₂₂H₁₇N₃O₂ · 0.5 H₂O) C, H, N.

79: 1 - (4 -) - 4 - - 8,9 - - 7HH - 2,7,9a - - [cdcd]
 - 6 -



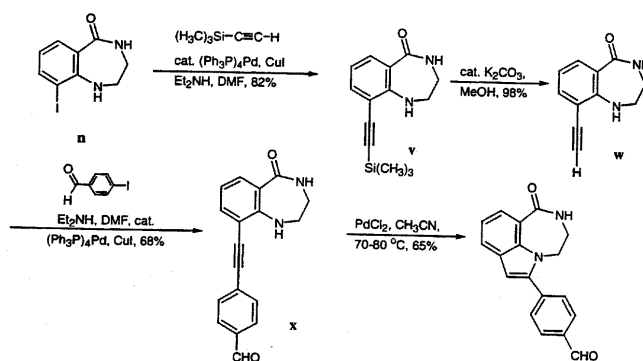
55, 18) 1.61g(79%) : mp= 219 - 221 ; R_f = 0.39(90% EtOAc/); IR(KBr) 1667, 1611, 1464 1107cm⁻¹; ¹H NMR(DMSO - d₆) 1.17(t, 6H, J= 7.0 Hz), 3.48 - 3.65(m, 6H), 4.45 - 4.47(m, 2H), 5.59(s, 1H), 7.58 - 7.62(m, 3H), 7.75 - 7.78(m, 1H), 7.87(d, 2 H, J= 8.3 Hz), 8.61(t, 1H, J= 8.3 Hz). HRMS calcd for C₂₁H₂₂N₃O₃ 383.1645(M⁺), found 383.1640. Anal. (C₂₁H₂₂N₃O₃) C, H, N.

80: 1 - (1HH - - 2 -) - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6 -



4, g - 2 - 0.047g(33%) : mp= 227 - 228 (dec); R_f = 0.13(5% MeOH/EtOAc); IR(KBr) 1645, 1611, 1497, 1402cm⁻¹; ¹H NMR(DMSO - d₆) 3.36 - 3.38(m, 2H), 3.46 - 3.50(m, 2H), 7.21(s, 1H), 7.35 - 7.40(m, 2H), 7.87 - 7.92(m, 2H), 8.42 - 8.45(m, 1H), 13.34(s, 1H). HRMS calcd for C₁₃H₁₁N₅O 253.0964(M⁺), found 253.0957. Anal. (C₁₃H₁₁N₅O · 0.25 MeOH) C, H, N.

81: 4 - (1 - - 1,2,3,4 - - [1,4] [6,7 - 1 - hihi] - 6 -) -



(a) v - 9 - () - 1,2,3,4 - [e][1,4] - 5 - :

n(34)(1.0g 3.47mmol), () (5.0Mℓ, 34.7mmol),
 (0)(0.04g 34.7 μ mol), (10Mℓ) Cul(0.013g 69.4 μ mol) DMF(10Mℓ)
 5 MgSO₄ , H₂O , EtOAc , CHCl₃ 0 - 5% MeOH
 0.733g(82%) : mp 180 - 182 ; ¹H NM
 R(DMSO - d₆) 0.25(s, 9H), 3.25 - 3.33(m, 2H), 3.51 - 3.55(m, 2H), 5.90(br s, 1H), 6.57(t, 1H,J= 6.0 H
 z), 7.35(d, 1H,J= 6.0 Hz), 7.78(d, 1H,J= 6.0 Hz), 8.13(t, 1H,J= 6.0 Hz). LRMS 258(M⁺).

(b) w - 9 - - 1,2,3,4 - [e][1,4] - 5 - :

MeOH(35Mℓ) v(0.712g 2.76mmol) K₂CO₃(0.038g, 0.276mmol) 2.
 5 MgSO₄ , H₂O , EtOAc ,
 0.50g(98%) , 가
 : mp 146 - 148 ; ¹H NMR(DMSO - d₆) 3.15 - 3.23(m, 2H), 3.48 - 3.52(m, 2H), 4.50(s, 1H), 6.
 13(br s, 1H), 6.57(t, 1H,J= 9.0 Hz), 7.37(d, 1H,J= 9.0 Hz), 7.79(d, 1H,J= 9.0 Hz), 8.10(t, 1H,J= 6.0 H
 z). LRMS 186(M⁺).

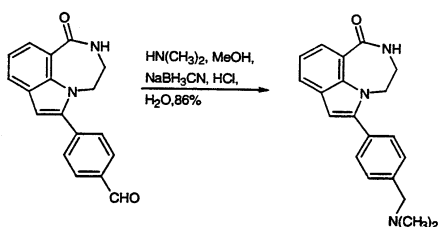
(c) x - 4 - (5 - - 2,3,4,5 - - 1H - [e][1,4] - 9 -) - :

o , w 4 - -
 x가 68% : mp 178 - 180 ; ¹H NMR(DMSO - d₆) 3.30 - 3.
 33(m, 2H), 3.54 - 3.57(m, 2H), 6.39(br s, 1H), 6.63(t, 1H,J= 6.0 Hz), 7.49(d, 1H,J= 6.0 Hz), 7.48 - 7.51
 (m, 3H), 7.95(d, 2H,J= 9.0 Hz), 8.15(t, 1H,J= 6.0 Hz). LRMS 290(M⁺).

(d) :

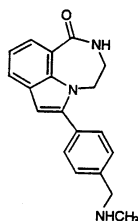
6 - - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (33)
 , x , 65% : mp 228
 - 230 ; ¹H NMR(DMSO - d₆) 3.46 - 3.49(m, 2H), 4.37 - 4.40(m, 2H), 6.89(s, 1H), 7.20(t, 1H,J= 6.0 H
 z), 7.81 - 7.88(m, 4H), 8.03(d, 2H,J= 9.0 Hz), 8.42(t, 1H,J= 6.0 Hz), 10.08(s, 1H). LRMS 290(M⁺).

82: 6 - (4 - -) - 3,4 - - 2HH - [1,4] - [6,7,1 - hihi] - 1 -



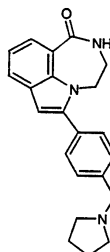
2M (8.2Mℓ, 16.34mmol) , MeOH(110Mℓ) 4 - (1 - - 1,2,3,4 -
 - [1,4] [6,7,1 - hi] - 6 -) - (0.55g, 1.90mmol) 가 .
 가 . , MeOH(55Mℓ)
 NaCNBH₃ (0.131g, 2.09mmol) ZnCl₂ (0.143g, 1.05mmol) 가 . pH 2M H
 Cl - 3 4 . 2.5 .
 , HCl 가 (pH 1), H₂O , 50% NaOH
 (pH 12 - 14), EtOAc . MgSO₄ ,
 CHCl₃ 0 - 7% MeOH , CHCl₃ 3 -
 8% MeOH/NH₃ , 0.52g(86%) : m
 p 140 - 142 ; ¹H NMR(DMSO - d₆) 2.18(s, 6H), 3.45(s, 2H), 3.47 - 3.50(m, 2H), 4.32(m, 2H), 6.69(s,
 1H), 7.16(t, 1H,J= 10 Hz), 7.42(d, 2H,J= 10 Hz), 7.56(d, 2H,J= 10 Hz), 7.77(d, 1H,J= 10 Hz), 7.81(d,
 1H,J= 10 Hz), 8.36(t, 1H,J= 5 Hz). HRMS calcd. for C₂₀ H₂₁ N₃ O 319.1685(M⁺), found 319.1678. Anal.(
 C₂₀ H₂₁ N₃ O · 0.3 H₂O) C, H, N.

83: 6 - (4 - -) - 3,4 - - 2 HH - [1,4] - [6,7,1 - hihi] - 1 -



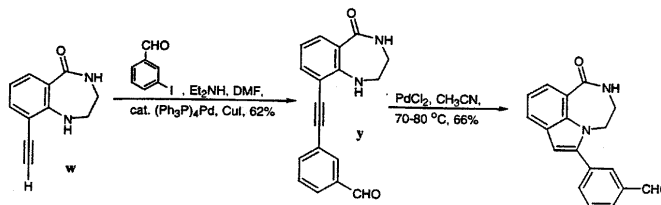
82 , 4 - (1 - - 1,2,3,4 - - [1,4] [6,7 -
 1 - hi] - 6 -) - , 71%
 : mp 178 - 180 ; ¹H NMR(DMSO - d₆) 2.29(s, 3H), 3.48(br s, 2H), 3.70(s, 2H), 4.30 - 4.33(m,
 2H), 6.68(s, 1H), 7.16(t, 1H,J= 9.0 Hz), 7.45(d, 2H,J= 6.0 Hz), 7.55(d, 2H,J= 6.0 Hz), 7.77(d, 1H,J= 9.
 0 Hz), 7.80(d, 1H,J= 9.0 Hz), 8.36(t, 1H,J= 6.0 Hz). HRMS calcd. for C₁₉ H₁₉ N₃ O 305.3828(M⁺), found
 305.1536. Anal.(C₁₉ H₁₉ N₃ O · 0.1H₂O) C, H, N.

84: 6 - (4 - - 1 - -) - 3,4 - - 2 HH - [1,4] - [6,7,1 - hihi] - 1 -



82
 1 - hi] - 6 -) - , 4 - (1 - - 1,2,3,4 - - [1,4] [6,7 -
 76%
 : mp 146 - 148 ; ¹H NMR(DMSO - d₆) 1.71(br s, 4H), 2.49(br s, 4H), 3.48(br s, 2H), 3.64(br s, 2H), 4.30 - 4.33(m, 2H), 6.69(s, 1H), 7.16(t, 1H, J = 9.0 Hz), 7.43(d, 2H, J = 9.0 Hz), 7.55(d, 2H, J = 9.0 Hz), 7.77(d, 1H, J = 9.0 Hz), 7.80(d, 1H, J = 9.0 Hz), 8.38(t, 1H, J = 6.0 Hz). HRMS calcd. for 345.1841 (M⁺), found 345.1835. Anal. (C₂₂H₂₃N₃O · 0.25 H₂O) C, H, N.

85: 3 - (1 - - 1,2,3,4 - - [1,4] [6,7 - 1 - hihi] - 6 -) -



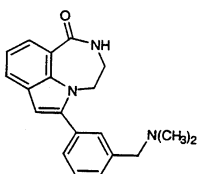
(a) y - 3 - (5 - - 2,3,4,5 - - 1H - [e][1,4] - 9 -) -
 :

o , w, 9 - - 1,2,3,4 - -
 [e][1,4] - 5 - 3 - - y가 , 62%
 : mp 176 - 178 ; ¹H(DMSO - d₆) 3.30 - 3.33(m, 2H), 3.54 - 3.57(m, 2H), 6.40(br s, 1H), 6.63(t, 1H, J = 6.0 Hz), 7.49(d, 1H, J = 6.0 Hz), 7.66(t, 1H, J = 9.0 Hz), 7.83(d, 1H, J = 6.0 Hz), 7.90 - 7.97(m, 2H), 8.15(br s, 1H), 8.31(s, 1H), 10.03(s, 1H). LRMS 291 (M⁺ + H).

(b) :

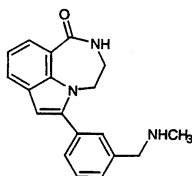
6 - - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (33)
 , y , 66% : mp 192
 - 194 ; ¹H NMR(DMSO - d₆) 3.49 - 3.51(m, 2H), 4.33 - 4.36(m, 2H), 6.83(s, 1H), 7.19(t, 1H, J = 6.0 Hz), 7.75(t, 1H, J = 9.0 Hz), 7.80 - 7.86(m, 2H), 7.96(d, 2H, J = 6.0 Hz), 8.15(s, 1H), 8.41(t, 1H, J = 6.0 Hz), 10.11(s, 1H). LRMS 290 (M⁺).

86: 6 - (3 - -) - 3,4 - - 2HH - [1,4] - [6,7,1 - hihi] - 1 -



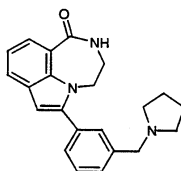
82, 3 - (1 - - 1,2,3,4 - - [1,4] [6,7 -
 1 - hi] - 6 -) - , 87%
 : mp 98 - 100 ; ¹H NMR(DMSO - d₆) 2.18(s, 6H), 3.47(br s, 4H), 4.30 - 4.32(m, 2H), 6.70(s, 1H),
 7.17(t, 1H, J= 6.0 Hz), 7.35 - 7.37(m, 1H), 7.43 - 7.50(m, 3H), 7.78(d, 1H, J= 6.0 Hz), 7.81(d, 1H, J= 6.0
 Hz), 8.38(t, 1H, J= 6.0 Hz). HRMS calcd. for C₂₀H₂₁N₃O 319.1685(M⁺), found 319.1682. Anal.(C₂₀H₂₁
 N₃O · 0.25 H₂O) C, H, N.

87: 6 - (3 - -) - 3,4 - - 2 HH - [1,4] - [6,7,1 - hihi] - 1 -



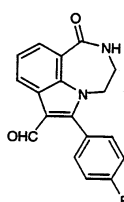
82, 3 - (1 - - 1,2,3,4 - - [1,4] [6,7 -
 1 - hi] - 6 -) - , 94%
 : mp 128 - 130 ; ¹H NMR(DMSO - d₆) 2.29(s, 3H), 3.48(br s, 2H), 3.71(s, 2H), 4.30 - 4.33(m,
 2H), 6.69(s, 1H), 7.17(t, 1H, J= 9.0 Hz), 7.38 - 7.39(m, 1H), 7.44 - 7.46(m, 2H), 7.54(s, 1H), 7.80(t, 2H,
 J= 9.0 Hz), 8.39(t, 1H, J= 6.0 Hz). HRMS calcd. for C₁₉H₁₉N₃O 305.3828(M⁺), found 305.1520. Anal.(
 C₁₉H₁₉N₃O · 0.6 H₂O) C, H, N.

88: 6 - (3 - - 1 - -) - 3,4 - - 2 HH - [1,4] - [6,7,1 - hihi] - 1 -



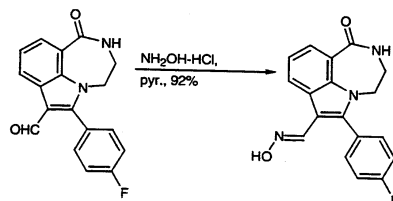
82, 3 - (1 - - 1,2,3,4 - - [1,4] [6,7 -
 1 - hi] - 6 -) - , 92%
 : mp 158 - 160 ; ¹H NMR(DMSO - d₆) 1.71(br s, 4H), 2.49(br s, 4H), 3.49(br s, 2H), 3.68(br
 s, 2H), 4.30 - 4.33(m, 2H), 6.70(s, 1H), 7.17(t, 1H, J= 9.0 Hz), 7.38 - 7.52(m, 4H), 7.79(d, 1H, J= 9.0 Hz),
 7.82(d, 1H, J= 9.0 Hz), 8.38(t, 1H, J= 6.0 Hz). HRMS calcd. for C₂₂H₂₃N₃O 345.1841(M⁺), found 345.1
 848. Anal.(C₂₂H₂₃N₃O · 0.4 H₂O) C, H, N.

89: 6 - (4 - -) - 1 - - 1,2,3,4 - - [1,4] - [6,7,1 - hihi] - 7 -



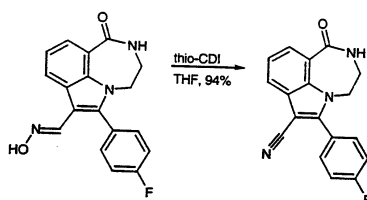
38, 6-(4-fluorophenyl)-1,2,3,4-tetrahydro-1H-indole-3-carboxylic acid, 94% yield. mp 268 - 270 °C; ¹H NMR(DMSO-d₆) 3.52 - 3.54(m, 2H), 4.19 - 4.22(m, 2H), 7.40 - 7.50(m, 3H), 7.75(d, 1H, J = 6.0 Hz), 7.78(d, 1H, J = 6.0 Hz), 8.46(d, 1H, J = 6.0 Hz), 8.52(t, 1H, J = 6.0 Hz), 9.64(s, 1H). LRMS 309(M⁺ + H).

90: 6-(4-fluorophenyl)-1,2,3,4-tetrahydro-1H-indole-3-carboxylic acid, 94% yield. mp 268 - 270 °C; ¹H NMR(DMSO-d₆) 3.52 - 3.54(m, 2H), 4.19 - 4.22(m, 2H), 7.40 - 7.50(m, 3H), 7.75(d, 1H, J = 6.0 Hz), 7.78(d, 1H, J = 6.0 Hz), 8.46(d, 1H, J = 6.0 Hz), 8.52(t, 1H, J = 6.0 Hz), 9.64(s, 1H). LRMS 309(M⁺ + H).



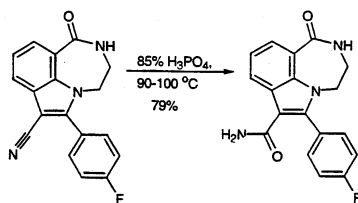
(10Mℓ) 6-(4-fluorophenyl)-1,2,3,4-tetrahydro-1H-indole-3-carboxylic acid (56.0mg, 0.813mmol) was dissolved in THF (70Mℓ) and treated with 2N HCl. The mixture was extracted with EtOAc and dried with MgSO₄. The solvent was removed, and the residue was purified by TLC (EtOAc/CHCl₃) to give 6-(4-fluorophenyl)-1,2,3,4-tetrahydro-1H-indole-3-carboxylic acid oxime (97mg, 92% yield). mp 277 - 279 °C; ¹H NMR(DMSO-d₆) 3.50(br s, 2H), 4.12 - 4.14(m, 2H), 7.30(t, 1H, J = 6.0 Hz), 7.43(t, 2H, J = 9.0 Hz), 7.57 - 7.62(m, 2H), 7.89(s, 1H), 7.94(d, 1H, J = 9.0 Hz), 8.33(d, 1H, J = 6.0 Hz), 8.41(t, 1H, J = 6.0 Hz), 10.80(s, 1H). HRMS calcd. for C₁₈H₁₄N₃O₂F 323.1070(M⁺), found 323.1066.

91: 6-(4-fluorophenyl)-1,2,3,4-tetrahydro-1H-indole-3-carboxylic acid oxime, 92% yield. mp 277 - 279 °C; ¹H NMR(DMSO-d₆) 3.50(br s, 2H), 4.12 - 4.14(m, 2H), 7.30(t, 1H, J = 6.0 Hz), 7.43(t, 2H, J = 9.0 Hz), 7.57 - 7.62(m, 2H), 7.89(s, 1H), 7.94(d, 1H, J = 9.0 Hz), 8.33(d, 1H, J = 6.0 Hz), 8.41(t, 1H, J = 6.0 Hz), 10.80(s, 1H). HRMS calcd. for C₁₈H₁₄N₃O₂F 323.1070(M⁺), found 323.1066.



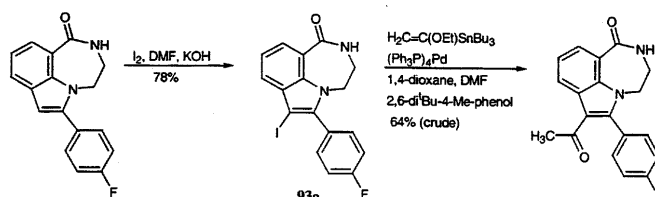
THF(70Mℓ) 6-(4-fluorophenyl)-1,2,3,4-tetrahydro-1H-indole-3-carboxylic acid oxime (0.301g, 0.932mmol) was dissolved in THF (70Mℓ) and treated with thio-CDI. The mixture was extracted with EtOAc and dried with MgSO₄. The solvent was removed, and the residue was purified by TLC (EtOAc/CHCl₃) to give 6-(4-fluorophenyl)-1,2,3,4-tetrahydro-1H-indole-3-carbonitrile (0.268g, 94% yield). mp 248 - 250 °C; ¹H NMR(DMSO-d₆) 3.52(br s, 2H), 4.29 - 4.31(m, 2H), 7.41 - 7.53(m, 3H), 7.77(d, 1H, J = 6.0 Hz), 7.80(d, 1H, J = 6.0 Hz), 7.90(d, 1H, J = 6.0 Hz), 8.01(d, 1H, J = 6.0 Hz), 8.55(t, 1H, J = 6.0 Hz). HRMS calcd. for C₁₈H₁₂N₃OF 305.0964(M⁺), found 305.0951. Anal.(C₁₈H₁₂N₃OF · 0.1 H₂O) C, H, N.

92: 6 - (4 -) - 1 - - 1,2,3,4 - - [1,4] - [6,7,1 - hihi] - 7 -



85% H₃PO₄ (7Mℓ) 6 - (4 -) - 1 - - 1,2,3,4 - - [1,4] - [6,7,
1 - hi] - 7 - (91)(0.05g,0.164mmol) 90 - 100 22 가 .
(TLC), H₂O , EtOAc .
MgSO₄ , , CHCl₃ 0 - 5% Me
OH , 0.042g(79%) . m
p 287 - 289 ; ¹H NMR(DMSO - d₆) 3.47(br s, 2H), 3.98 - 4.06(m, 2H), 6.46(br s, 1H), 7.09(br s, 1H),
7.28(t, 1H,J= 6.0 Hz), 7.38(t, 2H,J= 9.0 Hz), 7.56(d, 1H,J= 6.0 Hz), 7.60(d, 1H,J= 6.0 Hz), 7.90(d, 1H,
J= 6.0 Hz), 8.15(d, 1H,J=6.0 Hz), 8.40(t, 1H,J= 6.0 Hz). HRMS calcd. for C₁₈H₁₄N₃O₂F 323.1070(M⁺),
found 323.1063. Anal.(C₁₈H₁₄N₃O₂F · 0.5 H₂O) C, H, N.

93: 7 - - 6 - (4 - -) - 3,4 - - 2 HH - [1,4] - [6,7,1 - hihi] - 1 -



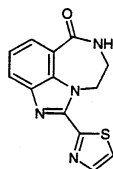
(a) 6 - (4 -) - 7 - - 1 - - 3,4 - - 2H - [1,4] - [6,7,1 - hi] - 1 -
:

43 , 6 - (4 -) - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1
- (37) 6 - (4 -) - 7 - - 1 - - 3,4 - - 2H - [1,4] - [6,7,
1 - hi] - 1 - 78% : mp 283 - 285 ; ¹H NMR(DMSO
- d₆) 3.48(br s, 2H), 4.15 - 4.18(m, 2H), 7.29(t, 1H,J= 6.0 Hz), 7.41(t, 2H,J= 9.0 Hz), 7.58 - 7.64(m,
3H), 7.94(d, 1H,J= 6.0 Hz), 8.41(t, 1H,J= 6.0 Hz). LRMS 407(M⁺ + H).

(b) :

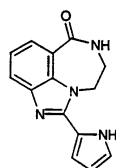
1,4 - (20ml) DMF(1ml) 6 - (4 -) - 7 - - 1 - - 3,4 - - 2H -
 [1,4] - [6,7,1 - hi] - 1 - (0.10g, 0.246mmol), (0.11ml, 0.320mmol),
 (14.0mg, 0.0123mmol) 2,6 - - t - - 4 - 90 - 95 20
 가 (TLC), 1
 N HCl , EtOAc MgSO₄ , ,
 , CHCl₃ 0 - 3% MeOH ,
 49.0mg(64%) , (preparative) HPLC
 36.0mg . 0.1% TFA 90% H₂O 0.1% TFA 10% CH₃CN 2
 , 22 0.1% TFA 35% H₂O 0.1% TFA 65% CH₃CN
 (gradient mobile phase) . Rt= 10.61min.
 15mg(26%) . mp 275 - 276 ; ¹H NMR(DMSO - d₆) 1.86(s, 3H), 3.45 - 3.52(m,
 2H), 3.96 - 3.98(m, 2H), 7.37(t, 1H, J= 6.0 Hz), 7.45(t, 2H, J= 9.0 Hz), 7.64(d, 1H, J= 6.0 Hz), 7.67(d, 1
 H, J= 6.0 Hz), 7.96(d, 1H, J= 6.0 Hz), 8.42(t, 1H, J= 6.0 Hz), 8.55(d, 1H, J= 6.0 Hz). HRMS calcd. for C
 9H₁₅ N₂ O₂ F 322.1117(M⁺), found 322.1131. Anal HPLC R_t = 8.61 min.

94: 1 - (- 2 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



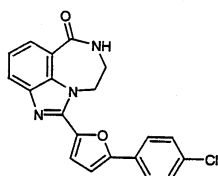
55 , g 2 - , 0.
 057g(37%) : mp= 271 - 276 ; R_f = 0.31(5% MeOH/EtOAc); IR(KBr) 1655, 1466,
 1379cm⁻¹; ¹H NMR(DMSO - d₆) 3.29 - 3.30(m, 2H), 3.63 - 3.68(m, 2H), 7.39 - 7.44(m, 1H), 7.94 - 7.97(
 m, 2H), 8.02 - 8.03(m, 1H), 8.11 - 8.13(m, 1H), 8.46 - 8.49(m, 1H). HRMS calcd for C
 13H₁₀N₄OS 270.0575(M⁺), found 270.0566. Anal.(C₁₃H₁₀N₄OS) C, H, N.

95: 1 - (1HH - - 2 -) - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6 -



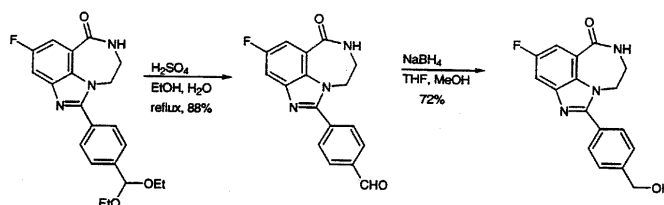
55 , g - 2 - , 0.
 061g(40%) : mp= 327 - 332 (dec); R_f = 0.25(5% MeOH/EtOAc); IR(KBr) 1651,
 1586, 1497, 1470cm⁻¹; ¹H NMR(DMSO - d₆) 3.35 - 3.36(m, 2H), 4.29 - 4.30(m, 2H), 6.04 - 6.06(m, 1H),
 6.52 - 6.54(m, 1H), 6.79 - 6.81(m, 1H), 7.07(t, 1H, J= 7.8 Hz), 7.53 - 7.57(m, 2H), 8.20(t, 1H, J= 5.6 Hz).
 HRMS calcd for C₁₄H₁₂N₄O 252.1011(M⁺), found 252.1008. Anal.(C₁₄H₁₂N₄O • 0.25 H₂O) C, H, N

96: 1 - [5 - (4 -) - - 2 -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] -
 6 -



55, 0.038g(22%)
 mp= 341 - 344 ; R_f = 0.31(5% MeOH/EtOAc); IR(KBr) 1651, 1487, 1381, 1090cm⁻¹; ¹H NMR(DMSO - d₆) 3.64 - 3.66(m, 2H), 4.70 - 4.71(m, 2H), 7.33 - 7.40(m, 3H), 7.54 - 7.58(m, 2H), 7.86 - 7.93(m, 4H), 8.47 - 8.51(m, 1H). HRMS calcd for C₂₀H₁₄N₃O₂Cl 363.0775(M⁺), found 363.0789. Anal.(C₂₀H₁₄N₃O₂Cl · 0.25 H₂O) C, H, N.

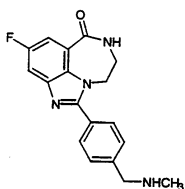
97: 4 - 1 - () - 8,9 - 7HH - 2,7,9a - [cdcd] - 6 -



(a) 4 - (4 - 6 - 6,7,8,9 - 2,7,9a - [cd] - 1 -) - (97a), 57, 1 - (4 -) - 4 - 8,9 - 7H - 2,7,9a - [cd] - 6 - (79), 1.11g(88%)
¹H NMR(DMSO - d₆) 3.55 - 3.56(m, 2H), 4.50 - 4.51(m, 2H), 7.64(dd, 1H, J= 2.6, 10.6 Hz), 7.81(dd, 1H, J= 2.6, 8.9 Hz), 8.10(s, 4H), 8.2 - 8.66(m, 1H), 10.13(s, 1H).

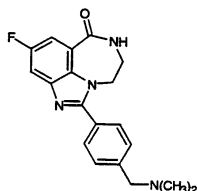
(b) :
 4 - (4 - 6 - 6,7,8,9 - 2,7,9a - [cd] - 1 -) - (97a), 1:1 THF/MeOH(2Mℓ), (0.014g, 0.36mmol) 가 , (0 - 2% MeOH/ EtOAc) 1, 0.073g(72%)
 mp= 273 - 275 ; R_f = 0.18(5% MeOH/EtOAc); IR(KBr) 1655, 1609, 1470, 1319cm⁻¹; ¹H NMR(DMSO - d₆) 3.54 - 3.55(m, 2H), 4.44 - 4.46(m, 2H), 4.60(d, 2H, J= 5.7 Hz), 5.36(t, 1H, J= 5.7 Hz), 7.52(d, 2H, J= 8.2 Hz), 7.59(dd, 1H, J= 2.6, 10.6 Hz), 7.75(dd, 1H, J= 9.0 Hz), 7.81(d, 2H, J= 8.2 Hz), 8.59 - 8.63(m, 1H). HRMS calcd for C₁₇H₁₄N₃O₂F 311.1070(M⁺), found 311.1058. Anal.(C₁₇H₁₄N₃O₂F) C, H, N.

98: 4 - 1 - (4 -) - 8,9 - 7HH - 2,7,9a - [cdcd] - 6 -



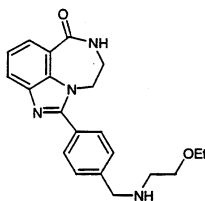
32, 97a (2M/MeOH), 0.069 g(42%) : mp= 204 - 208 (dec); $R_f = 0.03$ (7% / CHCl_3); IR(KBr) 1655, 1609, 1470, 1437 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 2.30(s, 3H), 3.54 - 3.55(m, 2H), 3.75(s, 2H), 4.45 - 4.46(m, 2H), 7.52(d, 2H, J= 8.2 Hz), 7.57 - 7.61(m, 1H), 7.73 - 7.76(m, 1H), 7.80(d, 2H, J= 8.2 Hz), 8.59 - 8.63(m, 1H). HRMS calcd for $\text{C}_{18}\text{H}_{17}\text{N}_4\text{OF}$ 324.1386(M^+), found 324.1378. Anal. ($\text{C}_{18}\text{H}_{17}\text{N}_4\text{OF} \cdot 0.3\text{H}_2\text{O}$) C, H, N.

99: 4 - 1 - (4 -) - 8,9 - 7 HH - 2,7,9a - [cdcd] - 6 -



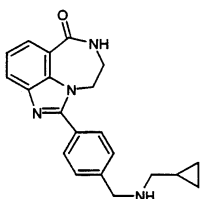
32, 97a (2M/MeOH), 0.010 g(60%) : mp= 240 (dec); $R_f = 0.08$ (7% / CHCl_3); IR(KBr) 1669, 1607, 1487, 1458 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 2.20(s, 6H), 3.51(s, 2H), 3.54 - 3.55(m, 2H), 4.45 - 4.47(m, 2H), 7.50(d, 2H, J= 8.2 Hz), 7.57 - 7.61(m, 1H), 7.73 - 7.76(m, 1H), 7.82(d, 2H, J= 8.2 Hz), 8.59 - 8.63(m, 1H). HRMS calcd for $\text{C}_{19}\text{H}_{19}\text{N}_4\text{OF}$ 338.1543(M^+), found 338.1558. Anal. ($\text{C}_{19}\text{H}_{19}\text{N}_4\text{OF} \cdot 0.2\text{H}_2\text{O}$) C, H, N. found 412.2124. Anal. ($\text{C}_{25}\text{H}_{25}\text{N}_5\text{O} \cdot 0.5\text{H}_2\text{O}, 3.5\text{ TFA}$) C, H, N.

100: 1 - {4 - [(2 -) -] - } - 8,9 - 7 HH - 2,7,9a - [cdcd] - 6 -



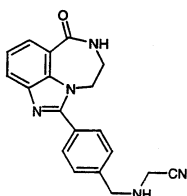
32, 57, 2-
 ; (77%) : mp= 138 - 140 ; R_f = 0.18(10% MeOH/CHCl₃); IR(KBr) 1663, 1483, 1381, 1086cm⁻¹; ¹H NMR(DMSO - d₆) 1.10(t, 3H, J=7.0 Hz), 2.65 - 2.69(m, 2H), 3.38 - 3.47(m, 4H), 3.52 - 3.53(m, 2H), 3.81(s, 2H), 4.45 - 4.46(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.52(d, 2H, J=8.2 Hz), 7.80(d, 2H, J=8.2 Hz), 7.84 - 7.90(m, 2H), 8.43 - 8.47(m, 1H). HRMS calcd for C₂₁H₂₄N₄O₂ 364.1899(M⁺), found 364.1906. Anal.(C₂₁H₂₄N₄O₂ · 0.2H₂O) C, H, N.

101: 1 - (4 -) - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6



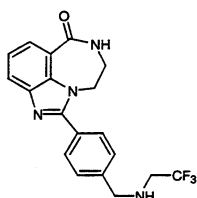
32, 57
 ; (71%) : mp= 84 (dec); R_f = 0.18(10% MeOH/CHCl₃); IR(KBr) 1655, 1481, 1381, 1308cm⁻¹; ¹H NMR(DMSO - d₆) 0.25 - 0.30(m, 2H), 0.33 - 0.40(m, 2H), 2.06 - 2.10(m, 1H), 3.52 - 3.52(m, 2H), 3.82(s, 2H), 4.44 - 4.46(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.52(d, 2H, J=8.2 Hz), 7.80(d, 2H, J=8.2 Hz), 7.84 - 7.90(m, 2H), 8.45(t, 1H, J=5.6 Hz). HRMS calcd for C₂₀H₂₀N₄O 332.1637(M⁺), found 332.1644. Anal.(C₂₀H₂₀N₄O · 0.4H₂O) C, H, N.

102: [4 - (6 - - 6,7,8,9 - - 2,7,9a - - [cdcd] - 1 -) -] -



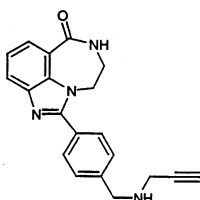
32, 57
 ; (25%) : mp= 198 - 202 (dec); R_f = 0.16(10% MeOH/CHCl₃); IR(KBr) 1626, 1483, 1464, 1379cm⁻¹; ¹H NMR(DMSO - d₆) 3.37 - 3.39(m, 2H), 3.64(s, 2H), 3.86(s, 2H), 4.45 - 4.46(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.53(d, 2H, J=8.2 Hz), 7.81 - 7.91(m, 4H), 8.43 - 8.47(m, 1H). HRMS calcd for C₁₉H₁₇N₅O 331.1433(M⁺), found 331.1442. Anal.(C₁₉H₁₇N₅O · 0.25H₂O) C, H, N.

103: 1 - {4 - [(2,2,2 -) -] - } - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



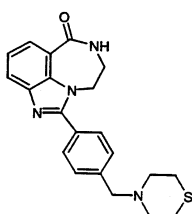
32 (62%) 57 2,2,2-
; : mp = 221 - 223 ; R_f = 0.08(5% MeOH/CHCl₃); IR(KBr) 1655, 1481, 1310, 1271cm⁻¹; ¹H NMR(DMSO - d₆) 3.04 - 3.08(m, 1H), 3.17 - 3.28(m, 2H), 3.52 - 3.53(m, 2H), 3.89(d, 2H, J=6.1 Hz), 4.45 - 4.46(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.53(d, 2H, J=8.1 Hz), 7.81 - 7.91(m, 4H), 8.43 - 8.47(m, 1H). HRMS calcd for C₁₉H₁₇N₄OF₃ 374.1354(M⁺), found 374.1342. Anal.(C₁₉H₁₇N₄OF₃) C, H, N.

104: 1 - (4 - 2 -) - 8,9 - 7 HH - 2,7,9a - [cdcd]
- 6 -



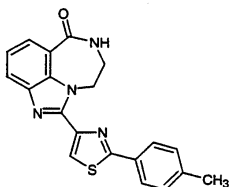
32 (60%) 57 (propargylamine)
; : mp = 126 (dec); R_f = 0.08(5% MeOH/CHCl₃); IR(KBr) 1651, 1481, 1464cm⁻¹; ¹H NMR(acetone - d₆) 2.69 - 2.71(m, 1H), 3.42(d, 2H, J=2.4 Hz), 3.77 - 3.78(m, 2H), 3.98(s, 2H), 4.57 - 4.60(m, 2H), 7.36(t, 1H, J=7.8 Hz), 7.58 - 7.60(m, 3H), 7.84 - 7.89(m, 3H), 7.98(dd, 1H, J=7.7, 1.0 Hz). HRMS calcd for C₂₀H₁₈N₄O 330.1481(M⁺), found 330.1472. Anal.(C₂₀H₁₈N₄O · 0.7H₂O) C, H, N.

105: 1 - (4 - 4 -) - 8,9 - 7 HH - 2,7,9a - [cdcd]
- 6 -



32
(79%) : mp= 266 (dec); $R_f = 0.18$ (5% MeOH/CHCl₃); IR(KBr) 1661, 1601, 1483, 1381cm⁻¹; ¹H NMR(DMSO - d₆) 2.62 - 2.66(m, 8H), 3.52 - 3.53(m, 2H), 3.60(s, 2H), 4.45 - 4.47(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.49(d, 2H, J=8.1 Hz), 7.81 - 7.90(m, 4H), 8.43 - 8.46(m, 1H). HRMS calcd for C₂₁H₂₂N₄OS 378.1514(M+), found 378.1521. Anal.(C₂₁H₂₂N₄OS • 0.25H₂O) C, H, N.

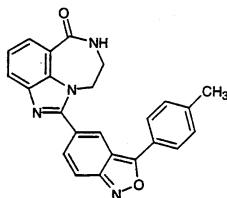
106: 1 - (2 - p - - 4 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



(a) 2 - p - - 4 - :
6 3 - , 2 - (4 -)
- 1,3 - - 4 - , 1.0g(quant) (tan) , 가
: mp= 92 - 95 ; IR(KBr) 1765, 1470, 1007cm⁻¹; ¹H NMR(CDCl₃) 2.42(s, 3H), 7.28(d, 2H, J=8.2 Hz), 7.89(d, 2H, J=8.2 Hz), 8.41(s, 1H).

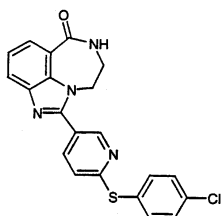
(b) :
4 , 2 - p - - 4 - C
H₂Cl₂ , 0.055g(27%) : mp= 308 - 313 ; $R_f = 0.5$ (5% MeOH/EtOAc); IR(KBr) 1653, 1487, 1464cm⁻¹; ¹H NMR(DMSO - d₆) 2.39(s, 3H), 3.29 - 3.30(m, 2H), 3.65 - 3.66(m, 2H), 7.35 - 7.40(m, 3H), 7.89 - 7.92(m, 2H), 7.98(d, 2H, J=8.1 Hz), 8.46 - 8.48(m, 1H), 8.50(s, 1H). HRMS calcd for C₂₀H₁₆N₄OS 360.1045(M+), found 360.1037. Anal.(C₂₀H₁₆N₄OS • 0.5H₂O) C, H, N.

107: 1 - (3 - pp - - [c] - 5 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



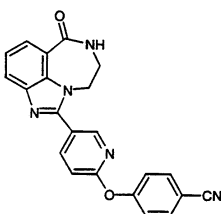
19, g(2) 3-(4-) -2,1-
 -5-; (18%); mp= 297-301 (dec); $R_f = 0.13$ (90% EtOAc/); IR(KBr) 1653, 1464, 1310 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 2.43(s, 3H), 3.54-3.55(m, 2H), 4.59-4.61(m, 2H), 7.39(t, 1H, $J=7.8$ Hz), 7.47(d, 2H, $J=8.1$ Hz), 7.82-7.95(m, 4H), 8.11(d, 2H, $J=8.2$ Hz), 8.49-8.52(m, 2H). HRMS calcd for $\text{C}_{24}\text{H}_{18}\text{N}_4\text{O}_2$ 394.1430(M $^+$), found 394.1446. Anal. ($\text{C}_{24}\text{H}_{18}\text{N}_4\text{O}_2 \cdot 0.5\text{H}_2\text{O}$) C, H, N.

108: 1-[6-(4-) -3-]-8,9-7 HH-2,7,9a- [cd]
 -6-



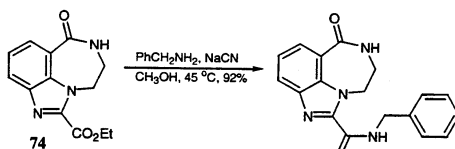
19, g(2) 6-[(4-)]
 ; (61%); mp= 280-284 (dec); $R_f = 0.21$ (90% EtOAc/); IR(KBr) 1669, 1586, 1387, 1013 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 3.50-3.51(m, 2H), 4.43-4.45(m, 2H), 7.21(d, 1H, $J=8.4$ Hz), 7.37(t, 1H, $J=7.8$ Hz), 7.60(d, 2H, $J=8.6$ Hz), 7.68(d, 2H, $J=8.6$ Hz), 7.86-7.93(m, 2H), 8.12-8.16(m, 1H), 8.45(t, 1H, $J=5.7$ Hz), 8.85(d, 1H, $J=1.7$ Hz). HRMS calcd for $\text{C}_{21}\text{H}_{15}\text{N}_4\text{OSCl}$ 406.0655(M $^+$), found 406.0651. Anal. ($\text{C}_{21}\text{H}_{15}\text{N}_4\text{OSCl} \cdot 0.2\text{H}_2\text{O}$) C, H, N.

109: 4-[5-(6-6,7,8,9-2,7,9a-1-)-2-]
]-



19, g(2) 4-[(5-2-)]
 ; (95%)가; mp= 281-288 (dec); $R_f = 0.24$ (5% MeOH/EtOAc); IR(KBr) 2228, 1669, 1603, 1258 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 3.54-3.55(m, 2H), 4.46-4.47(m, 2H), 7.35-7.42(m, 2H), 7.44(d, 2H, $J=8.8$ Hz), 7.86-7.91(m, 2H), 7.95(d, 2H, $J=8.8$ Hz), 8.38-8.41(m, 1H), 8.46(t, 1H, $J=5.7$ Hz), 8.65(d, 1H, $J=12.0$ Hz). HRMS calcd for $\text{C}_{22}\text{H}_{15}\text{N}_5\text{O}_2$ 381.1226(M $^+$), found 381.1211. Anal. ($\text{C}_{22}\text{H}_{15}\text{N}_5\text{O}_2 \cdot 1.2\text{H}_2\text{O}$) C, H, N.

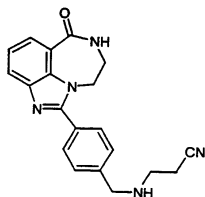
110: 6-6,7,8,9-2,7,9a- [cdcd] -1-



6 - - 6,7,8,9 - - 2,7,9a - - [cd] - 1 - (74)(0.
 07g, 0.27mmol) 0.9M MeOH (0.74M, 6.75mmol) 가 , 0.0013g(10
 mol%) 가 45 3 가 ,
 (1% MeOH/EtOAc) , 0.08g(92%)

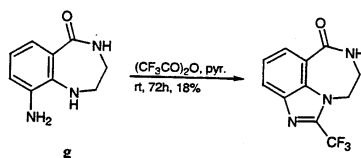
: mp= 247 - 250 ; R_f = 0.32(5% MeOH/EtOAc); IR(KBr) 1680, 1537, 1466, 758cm⁻¹; ¹H NMR(DMSO-d₆) 3.58 - 3.59(m, 2H), 4.47(d, 2H, J=6.4 Hz), 7.21 - 7.38(m, 5H), 7.44(t, 1H, J=7.8 Hz), 7.94 - 8.01(m, 2H), 8.43 - 8.47(m, 1H), 9.62(t, 1H, J=6.5 Hz). HRMS calcd for C₁₈H₁₆N₄O₂ 320.1273(M⁺), found 320.1276. Anal.(C₁₈H₁₆N₄O₂ · 0.2H₂O) C, H, N.

111: 3 - [4 - (6 - - 6,7,8,9 - - 2,7,9a - - [cdcd] - 1 -) -] -



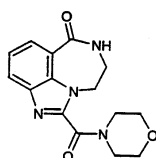
, 32 , 57 3 -
 ; (48%) : mp= 208 - 214 ; R_f = 0.05(5% MeOH/EtOAc); IR(KBr) 1661, 1601, 1485, 1312cm⁻¹; ¹H NMR(DMSO-d₆) 2.61 - 2.65(m, 2H), 2.73 - 2.78(m, 2H), 3.52 - 3.52(m, 2H), 3.82(s, 2H), 4.45 - 4.47(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.54(d, 2H, J=8.2 Hz), 7.82(d, 2H, J=8.2 Hz), 7.84 - 7.91(m, 2H), 8.43 - 8.47(m, 1H). HRMS calcd for C₂₀H₁₉N₅O 345.1590(M⁺), found 345.1586. Anal.(C₂₀H₁₉N₅O · 1.6H₂O) C, H, N.

112: 1 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



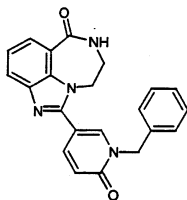
CH₂Cl₂ g ,
 0.26g(18%) : mp= 277 - 281 (dec); R_f = 0.18(75% EtOAc/); IR(KBr) 1671, 1609, 1474, 1123cm⁻¹; ¹H NMR(DMSO-d₆) 3.66 - 3.71(m, 2H), 4.50 - 4.51(m, 2H), 7.50(t, 1H, J=7.8 Hz), 8.03 - 8.09(m, 2H), 8.53(t, 1H, J=5.5 Hz). HRMS calcd for C₁₁H₈N₃OF₃ 255.0619(M⁺), found 255.0610. Anal.(C₁₁H₈N₃OF₃ · 0.1H₂O) C, H, N.

113: 1 - (- 4 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



110, EtOH, 0.056g(33%)
 : mp= 271 - 274 (dec); R_f = 0.08(5% MeOH/EtOAc); IR(KBr) 1657, 1462, 1219, 1111cm⁻¹; ¹H NMR(DMSO - d₆) 3.58 - 3.62(m, 2H), 3.69 - 3.70(m, 6H), 5.74 - 5.75(m, 2H), 7.40(t, 1H, J=7.8 Hz), 7.92 - 7.99(m, 2H), 8.43 - 8.45(m, 1H). HRMS calcd for C₁₅H₁₆N₄O₃ 300.1222 (M+), found 300.1230. Anal.(C₁₅H₁₆N₄O₃ · 0.4H₂O) C, H, N.

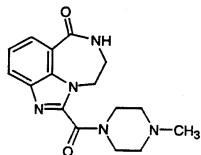
114: 1 - (1 - - 6 - - 1,6 - - - 3 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



(a) 1 - - 6 - - 1,6 - - - 3 - :
 , 106 , 1 - - 6 - - 1,6 - - 3 - : IR(KBr) 1750, 1671, 1223cm⁻¹ . 가

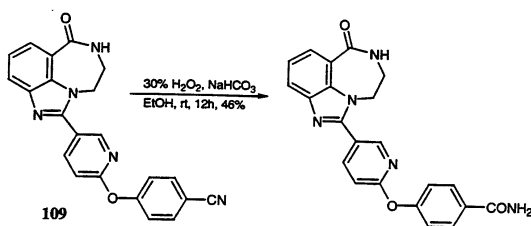
(b) :
 , 4 , g 1 - - 6 - - 1,6 - - - 3 - (= 72) CH₂Cl₂ , (tan) (36%) : mp= 265 - 269 (dec); R_f = 0.34(10% MeOH/CHCl₃); IR(KBr) 1671, 1618, 1508, 1142cm⁻¹; ¹H NMR(DMSO - d₆) 3.52 - 3.53(m, 2H), 4.43 - 4.44(m, 2H), 5.23(s, 2H), 6.70(d, 1H, J=9.5 Hz), 7.29 - 7.40(m, 6H), 7.81 - 7.85(m, 2H), 7.90 - 7.94(m, 1H), 8.44 - 8.47(m, 2H). HRMS calcd for C₂₂H₁₈N₄O₂ 370.1430(M+), found 370.1430. Anal.(C₂₂H₁₈N₄O₂ · 0.4H₂O) C, H, N.

115: 1 - (4 - - - 1 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



110, EtOH, 0.09g(47%)
 : mp= 311 - 316 (dec); R_f = 0.08(10% MeOH/CHCl₃); IR(KBr) 1682, 1638, 1508, 1225cm⁻¹; ¹H NMR(DMSO - d₆) 2.21(s, 3H), 2.33 - 2.36(m, 2H), 2.39 - 2.42(m, 2H), 3.59 - 3.71(m, 6H), 4.35 - 4.45(m, 2H), 7.40(t, 1H, J=7.8 Hz), 7.91 - 7.98(m, 2H), 8.41 - 8.45(m, 1H). HRMS calcd for C₁₆H₁₉N₅O₂ 313.1539(M+), found 313.1522. Anal.(C₁₆H₁₉N₅O₂ · 0.3H₂O) C, H, N.

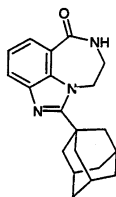
116: 4 - [5 - (6 - - 6,7,8,9 - - 2,7,9a - - [cdcd] - 1 -) - - 2 -] -



4 - [5 - (6 - - 6,7,8,9 - - 2,7,9a - - [cd] - 1 -) - - 2 -] -
 (109) (0.10g, 0.26mmol) EtOH(0.26Mℓ) . 30% H₂O₂ (0.16Mℓ) 가 , 3N NaH
 CO₃ (0.52Mℓ) 가 .

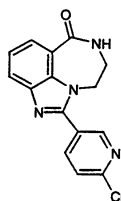
, 0.042g(46%) : mp= 244 - 248 (dec); R_f = 0.39(10% MeO
 H/EtOAc); IR(KBr) 1684, 1593, 1462, 1260cm⁻¹; ¹H NMR(DMSO - d₆) 3.55 - 3.56(m, 2H), 4.46 - 4.47(m,
 2H), 7.27 - 7.40(m, 5H), 7.86 - 7.99(m, 5H), 8.34 - 8.38(m, 1H), 8.45 - 8.47(m, 1H), 8.63 - 8.64(m, 1H). H
 RMS calcd for C₂₂ H₁₇ N₅ O₃ 399.1331(M+), found 399.1312. Anal.(C₂₂ H₁₇ N₅ O₃ · 1.0H₂O) C, H, N.

117: 1 - [3.3.1.1] - 1 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



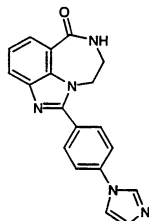
, g 1 - - 1 135 가
 , 0.12g(62%) : mp= 304 - 306 ; R_f = 0.21(90% EtOA
 c/); IR(KBr) 2906, 1656, 1491, 1462, 1308cm⁻¹; ¹H NMR(DMSO - d₆) 1.72 - 1.95(m, 6H), 2.07 - 2.1
 4(m, 3H), 2.26 - 2.27(m, 6H), 3.58 - 3.66(m, 2H), 4.80 - 4.87(m, 2H), 7.24(t, 1H, J=7.8 Hz), 7.75 - 7.83(m,
 2H), 8.34 - 8.38(m, 1H). HRMS calcd for C₂₀ H₂₃ N₃ O 321.1841(M+), found 321.1842. Anal.(C₂₀ H₂₃ N₃ O)
 C, H, N.

118: 1 - (6 - - 3 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



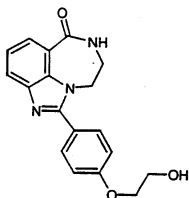
6, 0.31g(32%)
 : mp > 280 (dec); $R_f = 0.24$ (5% MeOH/EtOAc); IR(KBr) 1650, 1466, 1399 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 3.53 - 3.54(m, 2H), 4.47 - 4.49(m, 2H), 7.39(t, 1H, J=7.8 Hz), 7.77(d, 1H, J=8.3 Hz), 7.90(dd, 1H, J=8.0, 1.0 Hz), 7.95(dd, 1H, J=8.0, 1.0 Hz), 8.34(dd, 1H, J=8.3, 2.5 Hz), 8.46 - 8.50(m, 1H), 8.89(d, 1H, J=2.2 Hz). HRMS calcd for $\text{C}_{15}\text{H}_{11}\text{N}_4\text{OCl}$ 298.0621(M+), found 298.0609. Anal. ($\text{C}_{15}\text{H}_{11}\text{N}_4\text{OCl} \cdot 0.1\text{H}_2\text{O}$) C, H, N.

119: 1 - (4 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



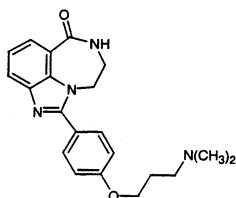
19, g(2) 4 - (1H - - 1 -)
 ; (85%)가 : mp > 300 (dec); $R_f = 0.11$ (7% MeOH/ CHCl_3); IR(KBr) 1640, 1487, 1382, 1271 1061 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 3.54 - 3.55(m, 2H), 4.50 - 4.51(m, 2H), 7.16(s, 1H), 7.35 - 7.40(m, 1H), 7.87 - 7.93(m, 5H), 8.01(d, 2H, J=8.5 Hz), 8.43(s, 1H), 8.47(t, 1H, J=5.6 Hz). HRMS calcd for $\text{C}_{19}\text{H}_{15}\text{N}_5\text{O}$ 329.1277(M+), found 329.1265. Anal. ($\text{C}_{19}\text{H}_{15}\text{N}_5\text{O} \cdot 0.3\text{H}_2\text{O}$) C, H, N.

120: 1 - [4 - (2 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



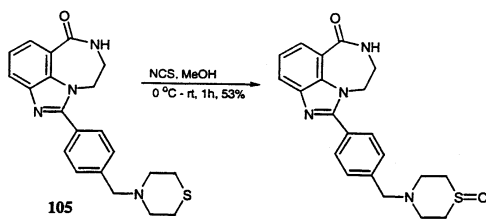
g 4 - (2 -)
 $\text{CH}_2\text{Cl}_2/\text{H}_2\text{O}$ 19, 0.89g(60%) : mp = 253 - 254 (dec); $R_f = 0.01$ (5% MeOH/EtOAc); IR(KBr) 1666, 1481, 1310, 1256 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 3.52 - 3.53(m, 2H), 3.75 - 3.76(m, 2H), 4.07 - 4.11(m, 2H), 4.43 - 4.45(m, 2H), 4.85 - 4.95(m, 1H), 7.13(d, 2H, J=8.8 Hz), 7.33(t, 1H, J=7.8 Hz), 7.78 - 7.87(m, 4H), 8.40(t, 1H, J=5.7 Hz). HRMS calcd for $\text{C}_{18}\text{H}_{17}\text{N}_3\text{O}_3$ 323.1270(M+), found 323.1268. Anal. ($\text{C}_{18}\text{H}_{17}\text{N}_3\text{O}_3 \cdot 2.0\text{H}_2\text{O}$) C, H, N.

121: 1 - [4 - (3 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



CHCl₃, 19, g 4 - [3 - ()]
 (49%) mp = 177 - 178 ; R_f = 0.1
 3(7% /CHCl₃); IR(KBr) 1650, 1483, 1380, 1254cm⁻¹; ¹H NMR(DMSO - d₆) 1.84 - 1.93(m, 2H), 2.18(s, 6H), 2.38 - 2.43(m, 2H), 3.52 - 3.53(m, 2H), 4.10(t, 2H, J=6.4 Hz), 4.42 - 4.45(m, 2H), 7.11 (d, 2H, J=8.8 Hz), 7.33(t, 1H, J=7.8 Hz), 7.79(d, 2H, J=8.8 Hz), 7.82 - 7.87(m, 2H), 8.38 - 8.42(m, 1H). H RMS calcd for C₂₁H₂₄N₄O₂ 364.1899(M⁺), found 364.1890. Anal.(C₂₁H₂₄N₄O₂ · 0.1H₂O) C, H, N.

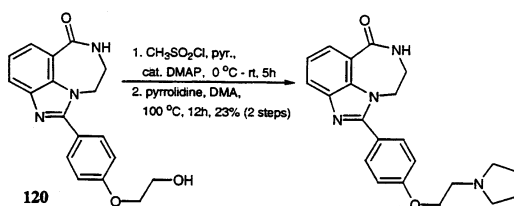
122: 1 - [4 - (- 1 4⁴ - - 4 -) -] - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6 -



1 - (4 - - 4 - -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (105)(0.058g, 0.15mmol) MeOH(3Ml), 0 . N - (0.021g, 0.15mmol) 가 , 0 1 , 3 - 10% MeOH/CHCl₃

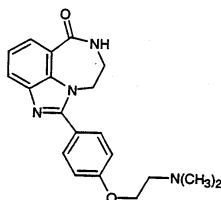
0.031(53%) : mp = 247 (dec); R_f = 0.18(10% MeOH/CHCl₃); IR(KBr) 1658, 1481, 1380, 1022cm⁻¹; ¹H NMR(DMSO - d₆) 2.66 - 2.80(m, 4H), 2.86 - 2.93(m, 4H), 3.53 - 3.54(m, 2H), 3.67(s, 2H), 4.45 - 4.48(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.53(d, 2H, J=7.8 Hz), 7.82 - 7.90(m, 4H), 8.40(m, 1H). HRMS calcd for C₂₁H₂₂N₄O₂S 394.1463(M⁺), found 394.1463. Anal.(C₂₁H₂₂N₄O₂S · 1.25H₂O) C, H, N.

123: 1 - [4 - (2 - - 1 - -) -] - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6 -



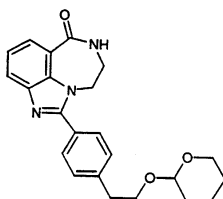
1 - [4 - (2 -) -] - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (12
 0)(0.51g, 1.91mmol) (16Mℓ) , 0 (0.15Mℓ, 1.91m
 mol) 가 , 0.01g 4 - 가 , 가 ,
 5 CHCl₃/
 (MgSO₄), , 0.25g (0.07Mℓ, 0.83mmol) 가 , 100 (0.
 11g, 0.28mmol) (3Mℓ) , 0 - 5% MeOH/CHCl₃ , 5% /CH
 Cl₃ (tan) 0.073g (1 - [4
 - (2 -) -] - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - ; 120
 24%): mp= 172 - 175 ; η = 0.18(7% /CHCl₃); IR(KBr) 1627, 1600, 1480, 125
 2cm⁻¹; ¹H NMR(DMSO - d₆) 1.75 - 1.71(m, 4H), 2.53 - 2.54(m, 4H), 2.83(t, 2H, J=5.8 Hz), 3.52 - 3.53(m,
 2H), 4.17(t, 2H, J=5.8 Hz), 4.43 - 4.45(m, 2H), 7.13(d, 2H, J=8.8 Hz), 7.33(t, 1H, J=7.8 Hz), 7.78 - 7.87(
 m, 4H), 8.41(t, 1H, J=5.6 Hz). HRMS calcd for C₂₂H₂₄N₄O₂ 376.1899(M⁺), found 376.1913. Anal.(C₂₂H
 24 N₄O₂) C, H, N.

124: 1 - [4 - (2 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



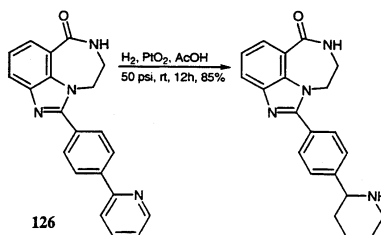
1 - [4 - (2 - 1 -) -] - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - ((123)
 (MeOH 2M , 1.03Mℓ, 2.05mmol) , 100 가 .
 , 0 - 5% MeOH/CHCl₃ 5% /CHCl₃
 , 0.051g(1 - [4 - (2 -) -] - 8,9 - - 7H - 2,
 7,9a - - [cd] - 6 - (120) 18%) : m
 p= 184 - 186 ; R_f = 0.26(7% /CHCl₃); IR(KBr) 1627, 1479, 1251, 1180cm⁻¹; ¹H NMR(DMS
 O - d₆) 2.23(s, 6H), 2.67(t, 2H, J=5.8 Hz), 3.52 - 3.53(m, 2H), 4.15(t, 2H, J=5.8 Hz), 4.43 - 4.44(m, 2H),
 7.13(d, 2H, J=8.7 Hz), 7.33(t, 1H, J=7.8 Hz), 7.78 - 7.87(m, 4H), 8.40(t, 1H, J=5.6 Hz). HRMS calcd for C
 20 H₂₂ N₄ O₂ 350.1743(M⁺), found 350.1756. Anal.(C₂₀ H₂₂ N₄ O₂) C, H, N.

125: 1 - {4 - [2 - (- 2 -) -] - } - 8,9 - - 7 HH - 2,7,9a -
 - [cdcd] - 6 -



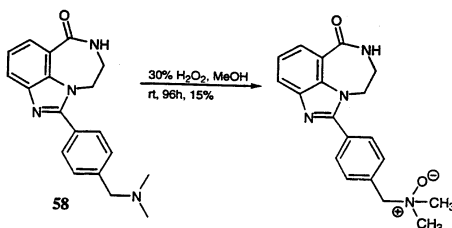
1 - [4 - (2 - 1 -) -] - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (123) , 85 가 1 - [4 - (2 -) -] - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (127) , 26% (2) : mp > 98 (dec); R_f = 0.08(7% /CHCl₃); IR(KBr) 1653, 1479, 1381, 1307cm⁻¹; ¹H NMR(DMSO - d₆) 2.21(s, 6H), 2.50 - 2.56(m, 2H), 2.79 - 2.84(m, 2H), 3.52 - 3.53(m, 2H), 4.44 - 4.46(m, 2H), 7.34(t, 1H, J=7.8 Hz), 7.43(d, 2H, J=8.2 Hz), 7.77(d, 2H, J=8.2 Hz), 7.84 - 7.90(m, 2H), 8.39 - 8.43(m, 1H). HRMS calcd for C₂₀H₂₃N₄O 335.1872(M+H), found 335.1865. Anal.(C₂₀H₂₂N₄O) C, H, N.

130: 1 - (4 - 2 -) - 8,9 - - 7HH - 2,7,9a - - [cdcd] - 6 -



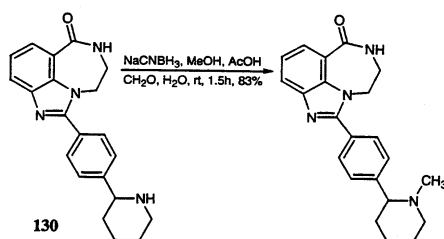
1 - (4 - 2 -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (126)(1.26g, 3.72mmol) (60Mℓ) (0.065g) 가 , 5 0psi , (Parr apparatus) , 1 - 9% / CHCl₃ , 1.45g(85%) : mp= 263 - 265 ; R_f = 0.08(7% /CHCl₃); IR(KBr) 1662, 1472, 1381, 840cm⁻¹; ¹H NMR(DMSO - d₆) 1.34 - 1.60(m, 4H), 1.74 - 1.81(m, 2H), 2.66 - 2.73(m, 1H), 3.07 - 3.11(m, 1H), 3.52 - 3.53(m, 2H), 3.66 - 3.69(m, 1H), 4.44 - 4.46(m, 2H), 7.35(t, 1H, J = 7.8 Hz), 7.56(d, 2H, J=8.3 Hz), 7.80(d, 2H, J=8.3 Hz), 7.84 - 7.90(m, 2H), 8.39 - 8.43(m, 1H). HRMS calcd for C₂₁H₂₁N₄O 345.1715(M - H), found 345.1719. Anal.(C₂₁H₂₂N₄O) C, H, N.

131: 1 - [4 - (- NN -) -] - 8,9 - - 7HH - 2,7,9a - - [c dcd] - 6 -



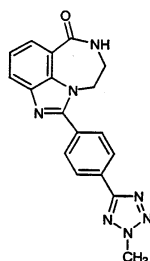
1 - (4 -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (58)(0.1
 9g, 0.60mmol) MeOH(10Mℓ) (30%) 가 ,
 4 0.2g 0.0
 5g , MetaSil AQ column(10 μ C18 120A 250 X 21.2mm) , 95% / 4
 , 12 40% / , 15 5% / , 20
 (R_t = 12.27 , = 15Mℓ/) HPLC(preparative HP
 LC) , 0.03g(15%) 가 : IR(KBr) 1645, 1463, 1382, 1308cm⁻¹; ¹H NMR
 R(DMSO - d₆) 3.03(s, 6H), 3.53 - 3.54(m, 2H), 4.41(s, 2H), 4.47 - 4.49(m, 2H), 7.36(t, 1H, J=7.8 Hz),
 7.78(d, 2H, J=8.2 Hz), 7.86 - 7.92(m, 4H), 8.42 - 8.46(m, 1H). HRMS calcd for ¹⁹H₂₁ N₄O₂ 337.1664(M+H),
 found 337.1661. Anal.(C₁₉H₂₁N₄O₂ · 2.0H₂O) C, H, N.

132: 1 - [4 - (1 - - 2 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



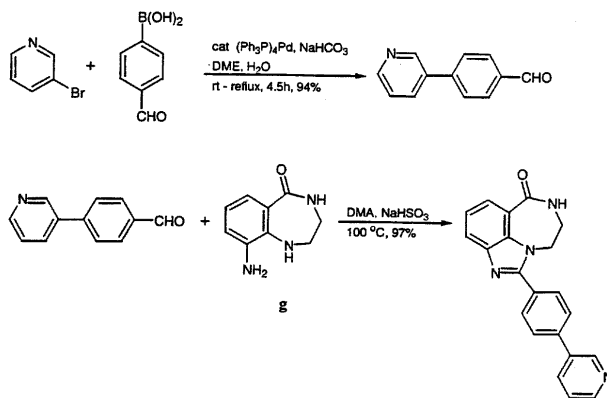
1 - (4 - - 2 - -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (130)(0.3
 1g, 0.89mmol) MeOH(13Mℓ) (0.21Mℓ, 0.89mmol) . NaCNBH₃ (0.056g, 0.89mmol) 가
 , (0.09Mℓ) 37% 5Mℓ MeOH 가 .
 1.5 , CH₂Cl₂/ NaHCO₃ .
 (MgSO₄). 0.25g(83%) : mp > 18
 0 (dec); R_f = 0.21(10% /CHCl₃); IR(KBr) 1662, 1601, 1479, 1309cm⁻¹; ¹H NMR(DMSO - d
 6) 1.23 - 1.78(m, 6H), 1.94(s, 3H), 2.02 - 2.11(m, 1H), 2.86 - 2.89(m, 1H), 2.95 - 2.99(m, 1H), 3.53 - 3.
 54(m, 2H), 4.45 - 4.48(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.49(d, 2H, J=8.2 Hz), 7.81(d, 2H, J=8.2 Hz), 7.84
 - 7.90(m, 2H), 8.39 - 8.43(m, 1H). HRMS calcd for C₂₂H₂₄N₄O 360.1950(M+), found 360.1942. Anal.(C
 22 H₂₄ N₄ O · 0.75H₂O) C, H, N.

133: 1 - [4 - (2 - - 2 HH - - 5 -) -] - 8,9 - - 7HH - 2,7,9a - - [cd
 cd] - 6 -



19
 [Bold, et al., J. Med. Chem. 41, 3387 (1998)]
 g 4 - (2 - - 2H - - 5 -) -
 (tan) (50%) : mp =
 280 (dec); $R_f = 0.29$ (5% MeOH/EtOAc); IR (KBr) 1667, 1455, 1306 cm^{-1} ; $^1\text{H NMR}$ (DMSO - d_6) 3.55 - 3.58 (m, 2H), 4.46 (s, 3H), 4.51 - 4.53 (m, 2H), 7.38 (t, 1H, $J = 7.8$ Hz), 7.88 - 7.94 (m, 2H), 8.07 (d, 2H, $J = 8.5$ Hz), 8.24 (d, 2H, $J = 8.5$ Hz), 8.42 - 8.46 (m, 1H). HRMS calcd for $\text{C}_{18}\text{H}_{15}\text{N}_7\text{O}$ 345.1338 (M+), found 345.1340. Anal. ($\text{C}_{18}\text{H}_{15}\text{N}_7\text{O} \cdot 0.25\text{H}_2\text{O}$) C, H, N.

134: 1 - (4 - - 3 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



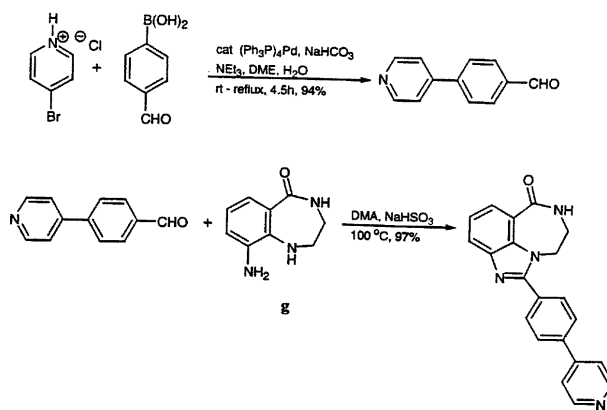
(a) 4 - - 3 - -

126 4 - - 2 - - , 3 -
 4 - (94%) : mp = 53 - 55 ; $R_f = 0.08$ (30% EtOAc/) ; IR (KBr) 1700, 1605, 1219 cm^{-1} ; $^1\text{H NMR}$ (CDCl_3) 7.55 - 7.60 (m, 1H), 7.76 - 7.79 (m, 2H), 8.01 - 8.05 (m, 2H), 8.08 - 8.12 (m, 1H), 8.69 - 8.71 (m, 1H), 8.94 - 8.95 (m, 1H), 10.10 (s, 1H). LRMS 184 (M+H).

(b) :

19
 (97%) : mp = 284 - 286 ; $R_f = 0.16$ (10% MeOH/EtOAc); IR (KBr) 1656, 1468, 1399, 1306 cm^{-1} ; $^1\text{H NMR}$ (DMSO - d_6) 3.55 - 3.58 (m, 2H), 4.51 - 4.54 (m, 2H), 7.37 (t, 1H, $J = 7.8$ Hz), 7.51 - 7.56 (m, 1H), 7.87 - 8.02 (m, 6H), 8.17 - 8.21 (m, 1H), 8.42 - 8.46 (m, 1H), 8.62 (dd, 1H, $J = 1.5, 4.8$ Hz), 9.00 (d, 1H, $J = 1.8$ Hz). HRMS calcd for $\text{C}_{21}\text{H}_{16}\text{N}_4\text{O}$ 340.1324 (M+), found 340.1313. Anal. ($\text{C}_{21}\text{H}_{16}\text{N}_4\text{O}$) C, H, N.

135: 1 - (4 - - 4 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



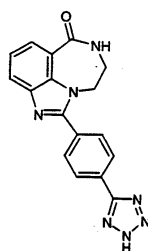
(a) 4 - - 4 - - (WO 9919300)

, 126 4 - - 2 - - , 4 - (51%)
 : mp= 90 - 91 ; R_f = 0.08(30% EtOAc/); IR(KBr) 1697, 1595, 1214, 1169, 801cm⁻¹; ¹H NMR(CDCl₃) 7.74(d, 2H, J=5.8 Hz), 7.84(d, 2H, J=8.3 Hz), 8.05(d, 2H, J=8.1 Hz), 8.77 - 8.78(m, 2H), 10.11(s, 1 H). LRMS 184(M+H).

(b) :

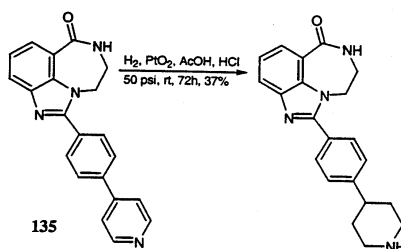
19 , g 4 - - 4 - - (55%) : mp= 370 - 372 (dec); R_f = 0.13(10% MeOH/EtOAc); IR(KBr) 1648, 1596, 1477, 1304cm⁻¹; ¹H NMR(DMSO - d₆) 3.55 - 3.56(m, 2H), 4.52 - 4.53(m, 2H), 7.38(t, 1H, J=7.8 Hz), 7.81 - 7.83(m, 2H), 7.88 - 7.94(m, 2H), 8.02(s, 4H), 8.42 - 8.46(m, 1H), 8.69(d, 2H, J=5.9 Hz). HRMS calcd for C₂₁ H₁₆ N₄ O 340.1324(M+), found 340.1330. Anal.(C₂₁ H₁₆ N₄ O) C, H, N.

136: 1 - [4 - (2 HH - - 5 -) -] - 8,9 - - 7HH - 2,7,9a - - [cdcd]
 - 6 -



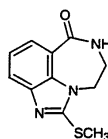
19, et al., J. Med. Chem. 41, 3387 (1998)]
 OH, 10% HCl pH 2
 : mp > 290 (dec); $R_f = 0.13$ (10% MeOH/0.5% HOAc/CHCl₃); IR (KBr) 1656, 1482, 1311, 1076 cm⁻¹; ¹H NMR (DMSO-d₆) 3.55 - 3.56 (m, 2H), 4.52 - 4.53 (m, 2H), 7.39 (t, 1H, J=7.8 Hz), 7.88 - 7.96 (m, 2H), 8.12 (d, 2H, J=8.5 Hz), 8.24 (d, 2H, J=8.5 Hz), 8.47 - 8.51 (m, 1H). HRMS calcd for C₁₇H₁₄N₇O 332.1260 (M+H), found 332.1257. Anal. (C₁₇H₁₃N₇O · 0.75H₂O) C, H, N.

137: 1 - (4 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



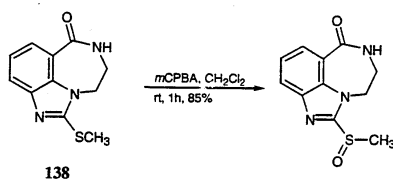
1 - (4 - -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (135) (0.24g,
 0.71 mmol) (15M) (0.015g) 가 , HCl
 , 50psi (Parr apparatus)
 가 0.02g HCl 가 ,
 3
 10 MeOH/CHCl₃ , 10% /CHCl₃
 , 0.091g (37%) : mp > 192 (dec); $R_f = 0.08$ (10% /CHCl₃); IR (KBr) 1653, 1601, 1479, 1382 cm⁻¹; ¹H NMR (DMSO-d₆) 1.54 - 1.66 (m, 2H), 1.74 - 1.78 (m, 2H), 2.53 - 2.75 (m, 2H), 3.06 - 3.17 (m, 2H), 3.51 - 3.52 (m, 2H), 4.45 - 4.46 (m, 2H), 7.34 (t, 1H, J=7.8 Hz), 7.43 (d, 2H, J=7.7 Hz), 7.77 (d, 2H, J=7.7 Hz), 7.81 - 7.90 (m, 2H), 8.42 - 8.46 (m, 1H). HRMS calcd for C₂₁H₂₂N₄O 346.1794 (M+), found 346.1778. Anal. (C₂₁H₂₂N₄O · 0.5H₂O) C, H, N.

138: 1 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



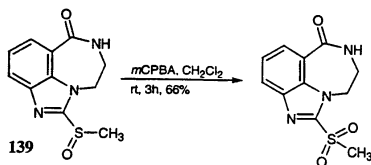
1 - - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (29)
 (65%)
 : mp = 223 - 225 ; $R_f = 0.29$ (3% MeOH/CHCl₃); IR (KBr) 1659, 1468, 1355 cm⁻¹; ¹H NMR (DMSO-d₆) 2.73 (s, 3H), 3.56 - 3.61 (m, 2H), 4.17 - 4.18 (m, 2H), 7.25 (t, 1H, J=7.8 Hz), 7.72 - 7.77 (m, 2H), 8.35 - 8.38 (m, 1H). HRMS calcd for C₁₁H₁₁N₃OS 233.0623 (M+), found 233.0613. Anal. (C₁₁H₁₁N₃OS · 0.2H₂O) C, H, N.

139: 1 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



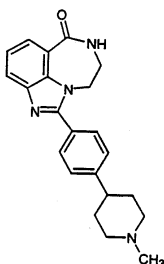
1 - - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (138) (0.29g, 1.25mmol)
 CH₂Cl₂ (25Mℓ) .m - CPBA (57 - 86%, 0.25g, 1eq. assuming 86%) 가 , 1
 가 m - CPBA 0.02g 가 , 15 , 0.26g
 1 - 3% /CHCl₃ , 0.26g
 (85%) : mp= 241 - 242 (dec); R_f = 0.24(7% /CHCl₃); IR(KBr) 1645, 1596, 1467,
 1358, 1081cm⁻¹; ¹H NMR(DMSO - d₆) 3.17(s, 3H), 3.65 - 3.66(m, 2H), 4.55 - 4.85(br, 2H), 7.42 - 7.48(
 m, 1H), 7.99 - 8.02(m, 2H), 8.50(t, 1H, J=5.5 Hz). HRMS calcd for C₁₁H₁₁N₃O₂S 249.0572(M⁺), found
 249.0583. Anal.(C₁₁H₁₁N₃O₂S) C, H, N.

140: 1 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



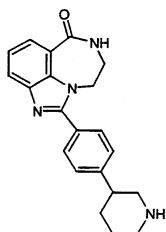
1 - - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (139) (0.05g, 0.20mmol)
 CH₂Cl₂ (4Mℓ) .m - CPBA (57 - 86%, 0.05g) 가 , 3
 가 0.015g m - CPBA 가 , 1 , 2%
 MeOH/CHCl₃ , 0.036g(66%) :
 mp > 190 (dec); R_f = 0.34(7% /CHCl₃); IR(KBr) 1658, 1474, 1372, 1317cm⁻¹; ¹H NMR(D
 MSO - d₆) 3.61(s, 3H), 3.66 - 3.71(m, 2H), 4.60 - 4.90(br, 2H), 7.52(t, 1H, J=7.8 Hz), 8.04 - 8.11(m, 2
 H), 8.52 - 8.56(m, 1H). HRMS calcd for C₁₁H₁₁N₃O₃S 265.0521(M⁺), found 265.0529. Anal.(C₁₁H₁₁N₃
 O₃S) C, H, N.

141: 1 - [4 - (1 - - 4 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



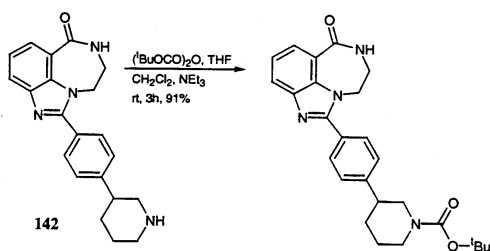
132, 1-(4-(4-(2-(1H-indolizin-5(1H)-ylidene)pyridin-2-yl)phenyl)piperidin-1-yl)ethanone (77%)
 mp > 240 (dec); $R_f = 0.21$ (10% CHCl_3); IR (KBr) 1662, 1473, 1379, 1304 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 1.69 - 1.81 (m, 4H), 2.00 - 2.07 (m, 2H), 2.23 (s, 3H), 2.53 - 2.58 (m, 1H), 2.89 - 2.93 (m, 2H), 3.51 - 3.52 (m, 2H), 4.45 - 4.47 (m, 2H), 7.34 (t, 1H, $J=7.8$ Hz), 7.45 (d, 2H, $J=8.2$ Hz), 7.79 (d, 2H, $J=8.3$ Hz), 7.84 - 7.90 (m, 2H), 8.44 (t, 1H, $J=5.6$ Hz). HRMS calcd for $\text{C}_{22}\text{H}_{24}\text{N}_4\text{O}$ 360.1950 (M+), found 360.1944. Anal. ($\text{C}_{22}\text{H}_{24}\text{N}_4\text{O} \cdot 0.25\text{H}_2\text{O}$) C, H, N.

142: 1-(4-(4-(2-(1H-indolizin-5(1H)-ylidene)pyridin-2-yl)phenyl)piperidin-1-yl)ethanone [cdcd] - 6-



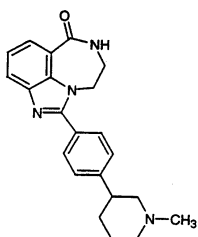
137, 134, 1-(4-(4-(2-(1H-indolizin-5(1H)-ylidene)pyridin-2-yl)phenyl)piperidin-1-yl)ethanone (71%)
 mp > 230 (dec); $R_f = 0.05$ (10% CHCl_3); IR (KBr) 1655, 1478, 1381, 1307 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 1.48 - 1.70 (m, 4H), 1.90 - 1.93 (m, 1H), 2.54 - 2.61 (m, 1H), 2.68 - 2.75 (m, 1H), 2.93 - 3.04 (m, 2H), 3.50 - 3.51 (m, 2H), 4.45 - 4.46 (m, 2H), 7.34 (t, 1H, $J=7.8$ Hz), 7.44 (d, 2H, $J=8.2$ Hz), 7.78 (d, 2H, $J=8.2$ Hz), 7.84 - 7.90 (m, 2H), 8.42 - 8.46 (m, 1H). HRMS calcd for $\text{C}_{21}\text{H}_{22}\text{N}_4\text{O}$ 346.1794 (M+), found 346.1788. Anal. ($\text{C}_{21}\text{H}_{22}\text{N}_4\text{O} \cdot 1.0\text{H}_2\text{O}$) C, H, N.

143: 3-(4-(6-(2-(1H-indolizin-5(1H)-ylidene)pyridin-2-yl)phenyl)piperidin-1-yl)propanoic acid [cdcd] - 1-



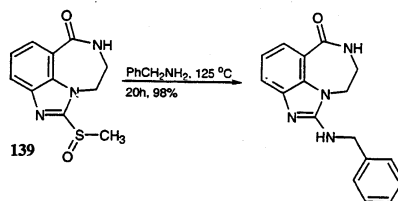
142 (0.13g, 0.37mmol) THF (4Ml) CH_2Cl_2 (3Ml) (0.062Ml, 0.45mmol) tert-butyl (0.10Ml, 0.45mmol) 1-3% MeOH/ CHCl_3
 mp = 202 - 203; $R_f = 0.21$ (7% MeOH/ CHCl_3); IR (KBr) 1660, 1418, 1308, 1173 cm^{-1} ; $^1\text{H NMR}$ (DMSO- d_6) 1.41 (s, 9H), 1.46 - 1.48 (m, 1H), 1.69 - 1.76 (m, 2H), 1.92 - 1.95 (m, 1H), 2.68 - 2.82 (m, 3H), 3.51 - 3.52 (m, 2H), 3.96 - 4.01 (m, 2H), 4.46 - 4.47 (m, 2H), 7.35 (t, 1H, $J=7.8$ Hz), 7.48 (d, 2H, $J=8.2$ Hz), 7.80 - 7.91 (m, 4H), 8.42 - 8.46 (m, 1H). HRMS calcd for $\text{C}_{26}\text{H}_{30}\text{N}_4\text{O}_3$ 446.2318 (M+), found 446.2311. Anal. ($\text{C}_{26}\text{H}_{30}\text{N}_4\text{O}_3$) C, H, N.

144: 1 - [4 - (- 3 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



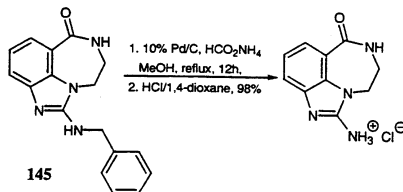
132 , 142 (5
8%) : mp= 240 - 242 ; R_f = 0.32(10% /CHCl₃); IR(KBr) 1628, 1480, 1462, 1380
cm⁻¹; ¹H NMR(DMSO - d₆) 1.45 - 2.18(m, 6H), 2.24(s, 3H), 2.87 - 2.90(m, 3H), 3.45 - 3.52(m, 2H), 4.4
5 - 4.46(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.47(d, 2H, J=8.3 Hz), 7.79(d, 2H, J=8.3 Hz), 7.84 - 7.90(m, 2H),
8.42 - 8.46(m, 1H). HRMS calcd for C₂₂H₂₄N₄O 360.1950(M⁺), found 360.1963. Anal.(C₂₂H₂₄N₄O · 0.5
H₂O) C, H, N.

145: 1 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



139(0.10g, 0.40mmol) (4Mℓ) , 125 20 가 . , 0.12g(98%)
1 - 5% MeOH/CHCl₃ , : mp= 186 (dec); R_f = 0.11(7% MeOH/CHCl₃); IR(KBr) 1644, 1572, 1466, 1368cm⁻¹; ¹H NMR(DMSO - d₆) 3.53 - 3.56(m, 2H), 4.04 - 4.05(m, 2H), 4.59(d, 2H, J=5.8 Hz), 7.02(t, 1H, J=7.
8 Hz), 7.20 - 7.41(m, 7H), 7.44 - 7.47(m, 1H), 8.18 - 8.22(m, 1H). HRMS calcd for C₁₇H₁₆N₄O 292.1324(
M⁺), found 292.1315. Anal.(C₁₇H₁₆N₄O) C, H, N.

146: 1 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



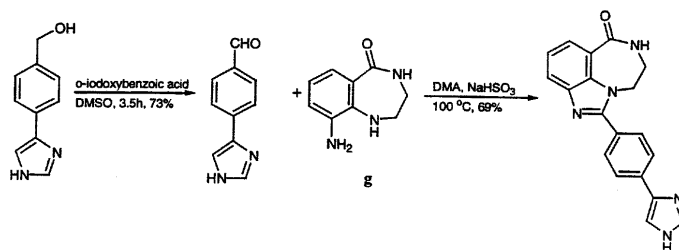
145 (0.08g, 0.27mmol) MeOH (0.09g, 1.36mmol) 가 10% (0.08g) 가

(2M) MeOH(2M) , 4M HCl/ (1M) , Et₂O , 0.06g(98%)

: mp > 260 (dec); IR(KBr) 1670, 1459, 1379, 754cm⁻¹; ¹H NMR(DMSO - d₆) 3.58 - 3.61(m, 2H), 4.10 - 4.11(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.58(dd, 1H, J=7.9, 1.0 Hz), 7.77(dd, 1H, J=7.9, 1.0 Hz), 8.50 - 8.54(m, 1H), 8.87(s, 2H), 13.05(br, 1H). HRMS calcd for C₁₀H₁₀N₄O 202.0854(M⁺), found 202.0853. Anal.(C₁₀H₁₀N₄O · HCl · 1.5H₂O) C, H, N.

147: 1 - [4 - (1 HH - - 4 -) -] - 8,9 - - 7HH - 2,7,9a - - [cdcd]

- 6 -



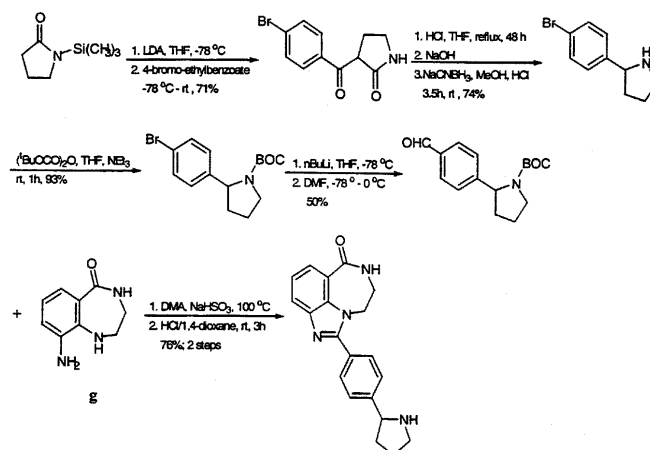
(a) 4 - (1H - - 4 -) - :

[4 - (1H - - 4 -) -] - (0.21g, 1.23mmol) DMSO(12M) .o - (Fr
igerio, et al., J. Org. Chem.1995, 60, 7272) (1.03g, 3.70mmol) 가 , 3.5
4:1 CHCl₃/iPrOH
5% Na₂SO₃/5% NaHCO₃ , (MgSO₄),
, 0.15g(73%) 4 - (1H - - 4 -) - 가
: (DMSO - d₆) 7.84 - 7.79(m, 2H), 7.87(d, 2H, J=8.4 Hz), 7.98(d, 2H, J=8.2 Hz), 9.94(s, 1H), 12.30 - 12.50(br, 1H).

(b) :

19 , 4 - (1H - - 4 -) - g
(tan) (69%) : mp > 198 (dec); R_f = 0.08(10% MeOH/CHCl₃); IR(KBr) 1647, 1473, 1381, 1309cm⁻¹; ¹H NMR(DMSO - d₆) 3.54 - 3.55(m, 2H), 4.49 - 4.50(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.77 - 7.98(m, 8H), 8.44 - 8.47(m, 1H), 12.25 - 12.40(br, 1H). HRMS calcd for C₁₉H₁₅N₅O 329.1277(M⁺), found 329.1280. Anal.(C₁₉H₁₅N₅O · 0.25H₂O) C, H, N.

148: 1 - (4 - - 2 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



(a) 3 - [1 - (4 - -) -] - 2 - :

(3.75Mℓ, 26.73mmol) THF(70Mℓ), -78, n - (2.5M/
 , 10.69Mℓ, 26.73mmol) 가 , 15 , 1 - () - 2
 - (Aldrich Chemical Co.) (4.28Mℓ, 25.67mmol) 가 , -78 15 .
 - 4 - (5.00g, 3.56Mℓ, 21.39mmol) 가 , 가 ,
 . THF . THF(70Mℓ) 10% HOAc(40Mℓ) . THF
 , . EtOAc (3X) , NaHCO₃ ,
 (MgSO₄). 0 - 2% MeOH/CHCl₃
 , 4.08g(71%) : mp= 167 - 169 ; R_f = 0.16(2% MeOH/CHCl₃); IR(KBr) 1699,
 1587, 1397, 1273cm⁻¹; ¹H NMR(DMSO - d₆) 2.18 - 2.28(m, 1H), 2.40 - 2.51(m, 1H), 3.24 - 3.30(m, 2H),
 4.55 - 4.60(m, 1H), 7.76(d, 2H, J=8.7 Hz), 7.95 - 7.99(m, 3H). LRMS 270(M+H).

(b) 2 - (4 - -) -

3 - [1 - (4 - -) -] - 2 - (4.08g, 15.21mmol) 6N HCl THF(60Mℓ)
 2 . THF , EtOAc .
 , 10% NaOH . Et₂O , (MgSO₄),
 MeOH(50Mℓ) (bromocresol green in
 dicator) 가 , NaCNBH₃ (1.01g, 15.37mmol) 가 . HCl MeOH 2M HCl
 /MeOH (10Mℓ) 가 , 3.5 .
 HCl 5Mℓ 가 . 가 ,
 Et₂O , 50% NaOH pH= 11 . Et₂O ,
 (MgSO₄), 2.54g(74%) : R_f = 0.16(5%
 /CHCl₃); IR(KBr) 1485, 1404, 1103, 1070, 1011cm⁻¹; ¹H NMR(Benzene - d₆) 1.23 - 1.49(m, 2H),
 1.55 - 1.60(m, 1H), 1.70 - 1.81(m, 1H), 2.55 - 2.64(m, 1H), 2.84 - 2.91(m, 1H), 3.59 - 3.64(m, 1H), 7.03(d,
 2H, J=8.3 Hz), 7.32(d, 2H, J=8.3 Hz). LRMS 226,228(M+H).

(c) 2 - (4 - -) - - 1 - tert -

2-(4-(tert-butyl)-1H-pyridin-2-yl)-1H-pyridin-3(2H)-one (0.49g, 1.77mmol) THF (9mL) (0.30mL, 2.12mmol) 가 , -tert-butyl- (0.49mL, 2.12mmol) 가 1 3-5% EtOAc/ , 0.53g(93%) : R_f = 0.18(10% EtOAc/); IR(KBr) 1703, 1487, 1400, 1167, 1117cm⁻¹; ¹H NMR(CDCl₃) major rotamer d 1.58(s, 9H), 1.72 - 1.92(m, 3H), 2.28 - 2.34(m, 1H), 3.58 - 3.60(m, 2H), 4.72(m, 1H), 7.04(d, 2H, J=8.3 Hz), 7.42(d, 2H, J=8.3 Hz). LRMS 350(M+Na).

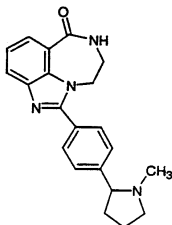
(d) 2-(4-(tert-butyl)-1H-pyridin-2-yl)-1H-pyridin-3(2H)-one - 1 - tert -

2-(4-(tert-butyl)-1H-pyridin-2-yl)-1H-pyridin-3(2H)-one (0.43g, 1.34 mmol) THF (4mL) , -78 n- (2.5M/ , 0.62mL, 1.6mmol) 가 -78 1 , DMF (0.13mL, 1.6mmol) 가 -78 1 NaHCO₃ (5M) 가 0 가 EtOAc/ 가 , (MgSO₄), 5-15% EtOAc/ , 0.18g(50%) : R_f = 0.13(20% EtOAc/); IR(KBr) 1696, 1607, 1393, 1165, 1113cm⁻¹; ¹H NMR(CDCl₃) major rotamer 1.58(s, 9H), 1.78 - 1.92(m, 3H), 2.35 - 2.37(m, 1H), 3.60 - 3.66(m, 2H), 4.82 - 4.84(m, 1H), 7.34(d, 2H, J=8.2 Hz), 7.83(d, 2H, J=8.3 Hz), 9.99(s, 1H). LRMS 220(M - C₄H₉ + H).

(e)

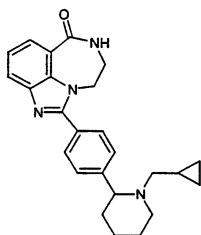
19 , 2-(4-(tert-butyl)-1H-pyridin-2-yl)-1H-pyridin-3(2H)-one (0.16g, 0.59mmol) g(0.11g, 0.61mmol) (8mL) , 4M HCl/ (4mL) , 3 3-5% MeOH/CHCl₃ , 5% /CHCl₃ , 0.14g(76%) : mp= 220 - 223 (dec); R_f = 0.11(7% /CHCl₃); IR(KBr) 1662, 1472, 1304, 741cm⁻¹; ¹H NMR(DMSO - d₆) 1.48 - 1.57(m, 1H), 1.72 - 1.83(m, 2H), 2.12 - 2.23(m, 1H), 2.88 - 2.96(m, 1H), 3.00 - 3.07(m, 1H), 3.51 - 3.52(m, 2H), 4.11 - 4.16(m, 1H), 4.45 - 4.46(m, 2H), 7.34(t, 1H, J=7.8 Hz), 7.56(d, 2H, J=8.2 Hz), 7.79(d, 2H, J=8.2 Hz), 7.84 - 7.90(m, 2H), 8.42 - 8.46(m, 1H). HRMS calcd for C₂₀H₁₈N₄O 330.1481(M - 2H), found 330.1480. Anal.(C₂₀H₂₀N₄O) C, H, N.

149: 1-[4-(1-(2-(tert-butyl)-1H-pyridin-2-yl)-1H-pyridin-3(2H)-one)-8,9-dihydro-7H-pyridin-2,7,9a-triylidene]-[cdcd] - 6 -



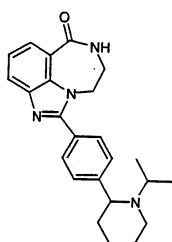
132, 1 - (4 - 2 -) - 8,9 - 7H -
 2,7,9a - [cd] - 6 - (148), (78%) : mp= 23
 5 - 238 (dec); IR(KBr) 2780, 1472, 1278cm⁻¹; ¹H NMR(DMSO - d₆) 1.61 - 1.70(m, 1H), 1.76 - 1.90(m,
 2H), 2.13(s, 3H), 2.17 - 2.29(m, 2H), 3.18 - 3.29(m, 2H), 3.52 - 3.53(m, 2H), 4.45 - 4.46(m, 2H), 7.35(t,
 1H,J=7.8 Hz), 7.52(d, 2H,J=7.8 Hz), 7.81 - 7.90(m, 4H), 8.42 - 8.46(m, 1H). HRMS calcd for C₂₁H₂₂N₄O
 346.1794(M⁺), found 346.1796. Anal.(C₂₁H₂₂N₄O · 0.3H₂O) C, H, N.

150: 1 - [4 - (1 - - 2 -) -] - 8,9 - 7 HH - 2,7,9a - -
 [cdcd] - 6 -



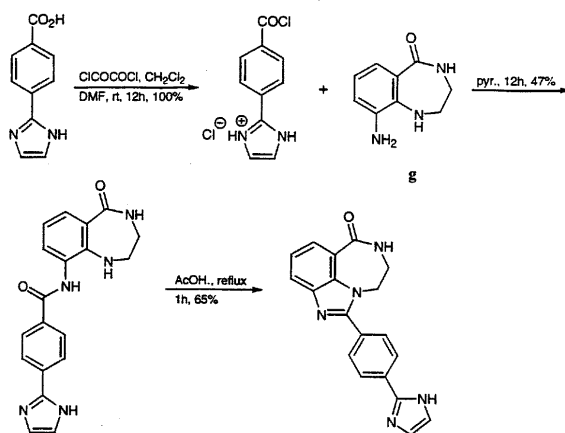
1 - (4 - 2 -) - 8,9 - 7H - 2,7,9a - [cd] - 6 - (130)(0.0
 6g, 0.19mmol) (0.11M, 1.53mmol), 132
 (0 - 1.5% MeOH/CHCl₃, 3%
 /CHCl₃) 0.054g(71%) : > 150 (dec); R_f = 0.26(5%
 /CHCl₃); IR(KBr) 1656, 1479, 1380, 1308cm⁻¹; ¹H NMR(DMSO - d₆) (-0.15) - (-0.10)(m, 2
 H), 0.31 - 0.42(m, 2H), 0.78 - 0.85(m, 1H), 1.32 - 1.80(m, 7H), 2.11 - 2.19(m, 1H), 2.26 - 2.33(m, 1H), 3.
 15 - 3.17(m, 1H), 3.36 - 3.37(m, 1H), 3.52 - 3.52(m, 2H), 4.46 - 4.48(m, 2H), 7.35(t, 1H,J=7.8 Hz), 7.50(
 d, 2H,J=8.2 Hz), 7.81(d, 2H,J=8.2 Hz), 7.84 - 7.89(m, 2H), 8.44(t, 1H,J=5.6 Hz). HRMS calcd for C₂₅H₂₈
 N₄O 400.2263(M⁺), found 400.2256. Anal.(C₂₅H₂₈N₄O · 0.25H₂O) C, H, N.

151: 1 - (4 - - 2 -) - 8,9 - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



132, 1-(4-(2-(1-(4-(1H-2,7,9a-H-2,7,9a-[cd]-6-(130)(0.077g, 0.22mmol) MeOH(5Mℓ), (0.05Mℓ) (1Mℓ) (0.044g) 가, CH₂Cl₂/NaHCO₃ (MgSO₄), 1% /CHCl₃, 0.26g(30%) : mp > 260 (dec); R_f = 0.34(7% /CHCl₃); IR(KBr) 1661, 1478, 1382, 1308cm⁻¹; ¹H NMR(DMSO-d₆) 0.77(d, 3H, J=6.3 Hz), 0.96(d, 3H, J=6.7 Hz), 1.29-1.52(m, 3H), 1.64-1.72(m, 3H), 2.13-2.20(m, 1H), 2.69-2.76(m, 1H), 2.92-2.96(m, 1H), 3.35-3.45(m, 1H), 3.52-3.53(m, 2H), 4.46-4.47(m, 2H), 7.35(t, 1H, J=7.8 Hz), 7.51(d, 2H, J=8.0 Hz), 7.80-7.89(m, 4H), 8.42-8.46(m, 1H). HRMS calcd for C₂₄H₂₈N₄O 388.2263(M⁺), found 388.2253. Anal.(C₂₄H₂₈N₄O · 0.7H₂O) C, H, N.

152: 1-[4-(1HH-2-)]-8,9-7HH-2,7,9a-[cdcd]-6-



(a) 4-(1H-2-)-:

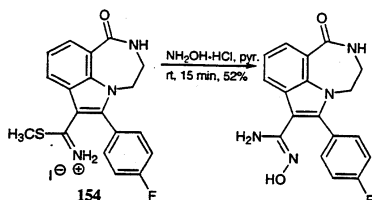
4-(1H-2-)- [J. Med. Chem.30, 1342(1987)] (0.69g, 3.70mmol) CH₂Cl₂ (20Mℓ) (0.39Mℓ, 4.44mmol) 가, DMF 가, 0.94g(quant) 가

(b) 4-(1H-2-)-N-(5-2,3,4,5-1H-[e][1,4]-9-)-

0.94g(quant) 가, g(0.60g, 3.40mmol) (35Mℓ) (0.91g, 3.74mmol) 가, 4:1 CHCl₃/iPrOH (0.56g(47%) 4-(1H-2-)-N-(5-2,3,4,5-1H-[e][1,4]-9-)- : ¹H NMR(DMSO-d₆) 2.48-2.50(m, 2H), 3.41-3.42(m, 2H), 5.57-5.59(m, 1H), 6.63(t, 1H, J=7.7 Hz), 7.18-7.20(m, 1H), 7.22(s, 2H), 7.69(dd, 1H, J=8.1, 1.6 Hz), 8.03-8.10(m, 5H), 9.65(s, 1H), 12.70-13.00(br, 1H). LRMS 348(M+H).

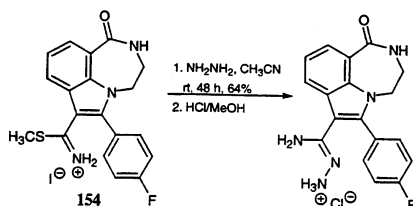
(3.218mmol, 0.2Mℓ) 50Mℓ THF 152(0.354mmol, 0.120g) 가 .
 18 (0.130g) , 가
 $^1\text{H NMR}$ (DMSO - d_6) 2.63(s, 3H), 3.51(br s, 2H), 4.01 - 4.05(m, 2H), 7.42 - 7.53(m, 3H), 7.62(d, 1H, J=6.0 Hz), 7.65(d, 1H, J=6.0 Hz), 8.02(d, 1H, J=3.0 Hz), 8.05(d, 1H, J=3.0 Hz), 8.57(t, 1H, J=6.0 Hz).

155: 6 - (4 -) - N - - 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hi
 hi] - 7 -



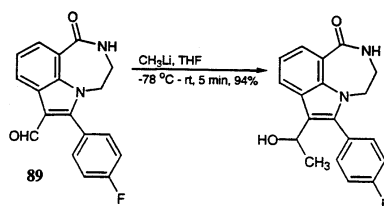
(0.852mmol, 0.059g) 5Mℓ 154(0.142mmol, 0.0
 5g) 가 . 15 (TLC),
 CHCl_3 0 - 5% MeOH
 0.025g(52%) : mp= 257 - 259 ; $^1\text{H NMR}$ (DMSO - d_6) 3.45 - 3.47(
 m, 2H), 4.10 - 4.12(m, 2H), 5.41(br s, 2H), 7.23(t, 1H, J=6.0 Hz), 7.34(t, 2H, J=9.0 Hz), 7.57(d, 1H, J=6.
 0 Hz), 7.59(d, 1H, J=6.0 Hz), 7.88(d, 1H, J=9.0 Hz), 7.93(d, 1H, J=9.0 Hz), 8.39(br s, 1H), 9.33(br s, 1H)
 ; HRMS calcd. for $\text{C}_{18}\text{H}_{15}\text{N}_4\text{O}_2\text{F}$ (M^+) 338.1179, found(M^+) 338.1182; Anal. ($\text{C}_{18}\text{H}_{15}\text{N}_4\text{O}_2\text{F} \cdot 0.5\text{H}_2\text{O}$)
 C, H, N.

156: 7 - - 6 - (4 -) - 1 - - 3,4 - - [1,4] [6,7,1 - hihi]



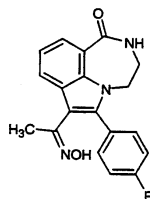
(2.82mmol, 0.092Mℓ) 25Mℓ 154(0.139mmol, 0.049g)
 가 . 48 (TLC),
 CHCl_3 0 - 10% MeOH , CHCl_3 2 - 10% MeO
 H/NH_3 , 0.028g(64%)
 HCl 가 가 MeOH , 30
 가 , (9mg) : mp= 272 - 274 ; $^1\text{H NMR}$ (DMSO - d_6) 3.5
 8(br s, 2H), 4.22 - 4.23(m, 2H), 5.18(br s, 2H), 7.37 - 7.46(m, 3H), 7.54 - 7.58(m, 2H), 7.82(d, 1H, J=6.0
 Hz), 8.00(d, 1H, J=6.0 Hz), 8.55(t, 1H, J=6.0 Hz), 8.79(br s, 1H), 9.08(br s, 1H), 10.60(br s, 1H); HRM
 S calcd. for $\text{C}_{18}\text{H}_{16}\text{N}_5\text{OF}$ (M^+) 337.1339, found(M^+) 337.1326.

157: 6 - (4 -) - 7 - (1 -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hi]



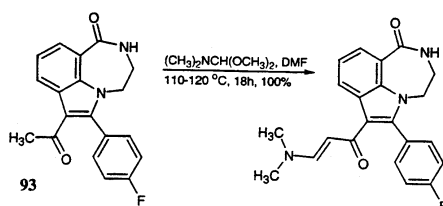
100Mℓ THF 89(0.487mmol, 0.150g) 1.5M (4.87mmol, 3.25Mℓ) - 78 가
 가 , 5 H₂O , EtOAc
 MgSO₄ (0.149g, 94%) , 가
 : mp= 220 - 222 ; ¹H NMR(DMSO - d₆) 1.47(d, 3H,J=6.0 Hz), 3.45(br s, 2H), 4.03(br s, 2H), 4.74 - 4.77(m, 1H), 4.96(d, 1H,J=3.0 Hz), 7.16(t, 1H,J=6.0 Hz), 7.38(t, 2H,J=9.0 Hz), 7.51 - 7.55(m, 2H), 7.84(d, 1H,J=6.0 Hz), 8.09(d, 1H,J=6.0 Hz), 8.31(t, 1H,J=6.0 Hz); HRMS calcd. for C₁₉ H₁₇ N₂ O₂ F(M⁺) 324.1274,found(M⁺) 324.1260; Anal. for(C₁₉ H₁₇ N₂ O₂ F • 0.1H₂O) C, H, N.

158: 6 - (4 -) - 7 - (1 -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi]



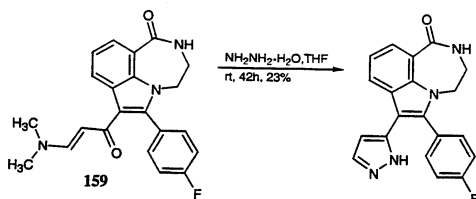
90 93
 60% : mp= 248 - 250 ; ¹H NMR(DMSO - d₆) 1.70(s, 3H), 3.49(br s, 2H), 4.07 - 4.09(m, 2H), 7.21(t, 1H,J=6.0 Hz), 7.37(t, 2H,J=9.0 Hz), 7.51(d, 1H,J=6.0 Hz), 7.55(d, 1H,J=6.0 Hz), 7.89(d, 1H,J=6.0 Hz), 8.09(d, 1H,J=6.0 Hz), 8.37(t, 1H,J=6.0 Hz), 10.93(s, 1H); HRMS calcd. for C₁₉ H₁₆ N₃ O₂ F(M⁺) 337.1226, found(M⁺) 337.1230; Anal. for(C₁₉ H₁₆ N₃ O₂ F • 0.1 H₂O) C, H, N.

159: 7 - [(EE) - 3 -] - 6 - (4 -) - 3,4 - - 2HH - [1,4] [6,7,1 - hihi]



N,N'-dimethyl-2-(4-fluorophenyl)-1H-indole-3-carboxamide (13.88mmol, 2Ml) DMF(1Ml) (0.217mmol, 0.070g) 가 TLC, 110 - 120 18, 0.101g() 가
 $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.30(s, 6H), 3.50(br s, 2H), 3.98 - 4.05(m, 2H), 4.61(d, 1H, J=12 Hz), 7.26(t, 1H, J=6.0 Hz), 7.35 - 7.43(m, 3H), 7.54 - 7.58(m, 2H), 7.89(d, 1H, J=6.0 Hz), 8.37 - 8.43(m, 2H); LC/MS(M⁺ + H) 378.

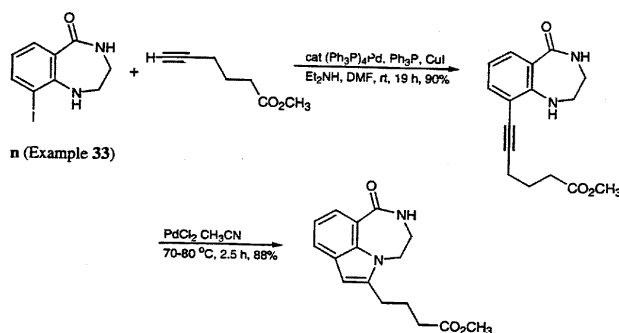
160: 6 - (4 -) - 7 - (2HH -) - 3 -) - 3,4 - - 2HH - [1,4] [6,7,1 - hihi] - 1 -



10Ml THF 7 - [(E) - 3 -] - 6 - (4 -) - 3,4 - - 2H - [1, 4] [6,7,1 - hi] - 1 - (159) (0.257mmol, 0.097g) , (5.14mmol, 0.26Ml) 2N HCl , EtOAc MgSO₄ , CHCl₃ 0 - 3% MeOH , 0.020g

: mp = 173 - 175 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.45 - 3.52(m, 2H), 4.03 - 4.08(m, 2H), 5.64(br s, 1H), 7.23(t, 1H, J=6.0 Hz), 7.32(t, 2H, J=9.0 Hz), 7.38 - 7.55(m, 3H), 7.88(d, 1H, J=6.0 Hz), 8.36 - 8.43(m, 2H), 12.67(br s, 1H); HRMS calcd. for C₂₀H₁₅N₄O₂(M⁺) 346.1221, found(M⁺) 346.1225; Anal. for(C₂₀H₁₅N₄O₂ · 1.0 MeOH) C, H, N.

161: (EE) - 5 - - 6 - (5 - - 2,3,4,5 -) - 1 HH - [e][1,4] - 9 -) - - 5 -



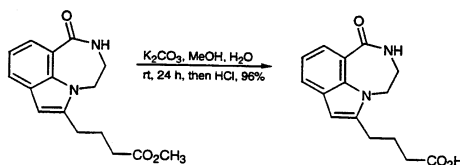
(a) 6 - (5 - - 2,3,4,5 -) - 1H - [e][1,4] - 9 -) - - 5 - :

30Mℓ DMF 30Mℓ n(33)(9.72mmol, 2.80g) ,
 (O)(0.194mmol, 0.224g), (0.0972mmol, 0.025g), - 5 - (Footnote)(3
 6.94mmol, 4.66g) CuI(0.194mmol, 0.037g) 가 . 19
 . TLC , H₂O , EtOAc
 MgSO₄ , ,
 EtOAc 0 - 5% MeOH , 2.51g(
 90%) : mp= 74 - 76 : ¹H NMR(DMSO - d₆) 1.78 - 1.87(m, 2H), 2.43 - 2.54(m, 4H),
 3.24 - 3.28(m, 2H), 3.48 - 3.52(m, 2H), 3.59(s, 3H), 6.01(br s, 1H), 6.54(t, 1H,J=9.0Hz), 7.29(d, 1H,J=
 9.0 Hz), 7.73(d, 1H,J=9.0 Hz), 8.04(t, 1H,J=6.0 Hz); HRMS calcd. for C₁₆H₁₈N₂O₃(M⁺) 286.1317, fou
 nd(M⁺) 286.1318.

(b)

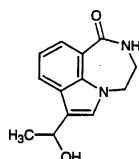
(0.418mmol, 0.074g) 50Mℓ CH₃CN 6 - (5 - - 2,3,4,5 - - 1H -
 [e][1,4] - 9 -) - - 5 - (8.36mmol, 2.39g) 가 .
 70 - 80 2.5 가 . EtOAc 0 - 5% MeOH
 , 2.11g(88%) : mp= 175 - 176 ; ¹H
 NMR(DMSO - d₆) 1.86 - 1.98(m, 2H), 2.43(t, 2H,J=6.0 Hz), 2.75(t, 2H,J=6.0 Hz), 3.52 - 3.54(m, 2H),
 3.57(s, 3H), 4.21(br s, 2H), 6.34(s, 1H), 7.07(t, 1H,J=6.0 Hz), 7.65(d, 1H,J=6.0 Hz), 7.75(d, 1H,J=6.0
 Hz), 8.23(t, 1H,J=6.0 Hz); HRMS calcd. for C₁₆H₁₈N₂O₃(M⁺) 286.1317, found(M⁺) 286.1310; Anal.(C
 16H₁₈N₂O₃ · 0.25 H₂O) C, H, N.

162: (EE) - 5 - - 6 - (5 - - 2,3,4,5 - - 1H - [ee][1,4] - 9 -) - - 5 -



(43.32mmol, 5.987g) , 200Mℓ MeOH 100Mℓ H₂O 161 (7.22mmol, 2.06
 6g)(, 가 (heat gun) 가) 가 . 24
 . MeOH , H₂O , EtOAc
 , 2N HCl (pH 0 - 1) .
 H₂O , (1.878g; 96%). 가 : mp= 257
 - 259 ; ¹H NMR(DMSO - d₆) 1.83 - 1.93(m, 2H), 2.33(t, 2H,J=6.0 Hz), 2.75(t, 2H,J=6.0 Hz), 3.52 - 3.
 56(m, 2H), 4.22(br s, 2H), 6.34(s, 1H), 7.07(t, 1H,J=6.0 Hz), 7.65(d, 1H,J=6.0 Hz), 7.75(d, 1H,J=6.0
 Hz), 8.23(t, 1H,J=6.0 Hz), 11.98(br s, 1H); HRMS calcd. for C₁₅H₁₆N₂O₃(M⁺) 272.1161, found(M⁺) 2
 72.1151.

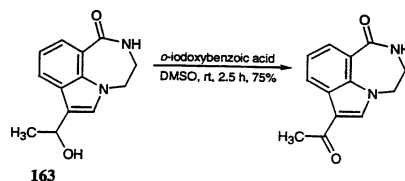
163: 7 - (1 -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



157, 1 - - 1,2,3,4 - - [1,4]
 [6,7,1 - hi] - 7 - (45), 69%

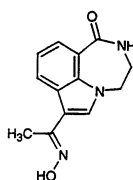
: mp= 295 - 297 ; ¹H NMR(DMSO - d₆) 1.47(d, 3H,J=6.0 Hz), 3.50 - 3.55(m, 2H), 4.29 - 4.31(m, 2H), 4.95(d, 1H,J=6.0 Hz), 4.97 - 5.03(m, 1H), 7.10(t, 1H,J=6.0 Hz), 7.25(s, 1H), 7.81(d, 1H,J=6.0 Hz), 7.86(d, 1H,J=6.0 Hz), 8.25(t, 1H,J=6.0 Hz); HRMS calcd. for C₁₃H₁₄N₂O₂(M⁺) 231.1134, found(M⁺) 231.1143; Anal.(C₁₃H₁₄N₂O₂) C, H, N.

164: 7 - - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



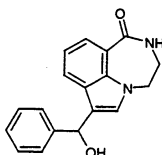
o - (Frigerio, et al.,J. Org. Chem.1995, 60,7272) (2.217mmol, 0.621g) DMSO(8Ml)
 7 - (1 - -) - 3,4 - - 2H - [1,4] [6,7,1 - hi] - 1 - (163)(0.739mmol, 0.170g) 가 . 2.5 . ,
 EtOAc , 5% Na₂S₂O₃/5% NaHCO₃, H₂O . MgSO₄
 , . CHCl₃ 0 - 5% MeOH
 , 0.094g(75%) : mp= 285 - 287 ;
¹H NMR(DMSO - d₆) 2.42(s, 3H), 3.56 - 3.61(m, 2H), 4.44(br s, 2H), 7.32(t, 1H,J=6.0 Hz), 7.92(d, 1H,J=6.0 Hz), 8.40 - 8.44(m, 3H); HRMS calcd. for C₁₃H₁₂N₂O₂(M⁺) 228.0899, found(M⁺) 228.0890; Anal.(C₁₃H₁₂N₂O₂) C, H, N.

165: 7 - (1 - -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



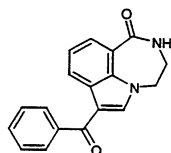
, 68% 90 , 164
 : mp= 238 - 240 ; ¹H NMR(DMSO - d₆) 2.16(s, 3H), 3.56(br s, 2H), 4.36(br s, 2H), 7.19(t, 1H,J=6.0 Hz), 7.77(s, 1H), 7.87(d, 1H,J=6.0 Hz), 8.33(t, 1H,J=6.0 Hz), 8.38(d, 1H,J=6.0 Hz), 10.67(s, 1H); HRMS calcd. for C₁₃H₁₃N₃O₂(M⁺) 243.1008, found(M⁺) 243.0997; Anal.(C₁₃H₁₃N₃O₂) C, H, N.

166: 7 - (1 - - 1 - -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



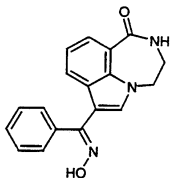
157
 - 1,2,3,4 - [1,4] [6,7,1 - hi] - 7 - (45)
 , 74% : mp= 178 - 180 ; ¹H NMR(DMSO - d₆) 3.51 - 3.52(m, 2H),
 4.28 - 4.29(m, 2H), 5.70(d, 1H,J=6.0 Hz), 5.96(d, 1H,J=6.0 Hz), 7.05(t, 1H,J=6.0 Hz), 7.14(s, 1H), 7.1
 7 - 7.22(m, 1H), 7.30(t, 2H,J=6.0 Hz), 7.45(d, 2H,J=6.0 Hz), 7.72(d, 1H,J=6.0 Hz), 7.79(d, 1H,J=6.0 H
 z), 8.24(t, 1H,J=6.0 Hz); HRMS calcd. for C₁₈ H₁₆ N₂ O₂(M⁺) 292.1212, found(M⁺) 292.1202; Anal.(C₁₈
 H₁₆ N₂ O₂ · 0.25 H₂O) C, H, N.

167: 7 - (1 -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



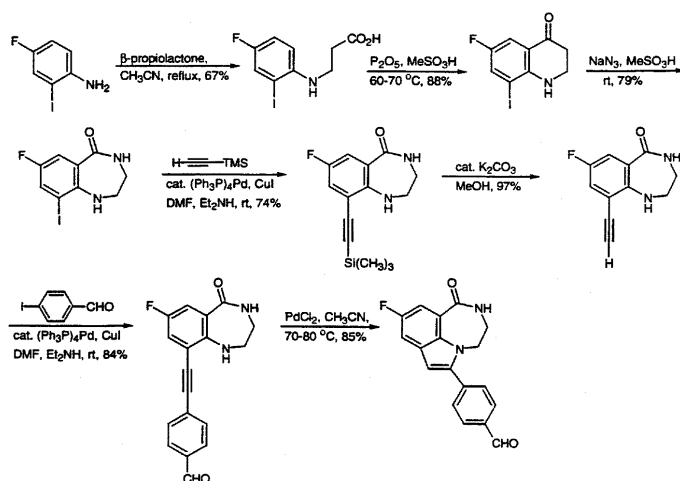
164
 0% : mp= 229 - 230 ; ¹H NMR(DMSO - d₆) 3.58 - 3.61(m, 2H), 4.4
 7(br s, 2H), 7.40(t, 1H,J=6.0 Hz), 7.52 - 7.65(m, 3H), 7.79 - 7.82(m, 2H), 7.98(d, 1H,J=6.0 Hz), 8.08(s,
 1H), 8.44(t, 1H,J=6.0 Hz), 8.51(d, 1H,J=6.0 Hz); HRMS calcd. for C₁₈ H₁₄ N₂ O₂(M⁺) 290.1055, found(
 M⁺) 290.1042; Anal.(C₁₈ H₁₄ N₂ O₂) C, H, N.

168: 7 - (1 -) - 1 - -) - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



90
 76% : mp= 263 - 265 ; ¹H NMR(DMSO - d₆) 3.51(br s, 2H), 3.60(
 br s, 2H), 4.29(br s, 2H), 4.45(br s, 2H), 6.97 - 7.04(m, 3H), 7.24(t, 1H,J=6.0 Hz), 7.34 - 7.46(m, 10H),
 7.82(d, 1H,J=6.0 Hz), 7.89 - 7.93(m, 2H), 8.31 - 8.36(m, 3H), 10.74(s, 1H), 11.37(s, 1H); HRMS calcd.
 for C₁₈ H₁₅ N₃ O₂(M⁺) 305.1164, found(M⁺) 305.1177; Anal.(C₁₈ H₁₅ N₃ O₂ · 0.1 H₂O) C, H, N.

169: 4 - (9 -) - 1 - - 1,2,3,4 - - [1,4] [6,7,1 - hihi] - 6 -) -



33 81 , 4 - - 2 - (Beugelmans, et al., Bull. Soc. Chim. Fr., 1995, 132, 306)

(a) 3 - (4 - - 2 - -) - :

(67%); mp= 163 - 165 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.50 - 2.54(m, 2H), 3.27 - 3.33(m, 2H), 4.72(t, 1H, J=6.0 Hz), 6.61(dd, 1H, J=9.0 Hz, 3.0 Hz), 7.06 - 7.12(m, 1H), 7.52(dd, 1H, J=9.0 Hz, 3.0 Hz), 12.27(br s, 1H); LCMS(M⁺ + H) 310.

(b) 6 - - 8 - - 2,3 - - 1H - - 4 - :

(88%); mp= 110 - 112 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.52 - 2.57(m, 2H), 3.45 - 3.51(m, 2H), 6.04(br s, 1H), 7.36(dd, 1H, J=9.0, 3.0 Hz), 7.82(dd, 1H, J=9.0 Hz, 3.0 Hz); LCMS(M⁺ + H) 292.

(c) 7 - - 9 - - 1,2,3,4 - - [e][1,4] - 5 - :

(79%); mp= 138 - 140 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.22 - 3.29(m, 2H), 3.43 - 3.47(m, 2H), 5.29(br s, 1H), 7.50(dd, 1H, J=9.0 Hz, 3.0 Hz), 7.75(dd, 1H, J=9.0, 3.0 Hz) 8.29(br s, 1H); LCMS(M⁺ + H) 307.

(d) 7 - - 9 - - 1,2,3,4 - - [e][1,4] - 5 - :

(74%); mp= 150 - 152 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 0.24(s, 9H), 3.25 - 3.31(m, 2H), 3.49 - 3.53(m, 2H), 5.83(t, 1H, J=6.0 Hz), 7.28(dd, 1H, J=9.0 Hz, J=3.0 Hz), 7.54(dd, 1H, J=9.0, 3.0 Hz) 8.27(t, 1H, J=6.0 Hz); LCMS(M⁺ + H) 277.

(e) 9 - - 7 - - 1,2,3,4 - - [e][1,4] - 5 - :

(97%); mp= 142 - 144 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.24 - 3.28(m, 2H), 3.45 - 3.50(m, 2H), 4.63(s, 1H), 6.07(t, 1H, J=6.0 Hz), 7.32(dd, 1H, J=9.0, 3.0 Hz), 7.54(dd, 1H, J=9.0, J=3.0 Hz), 8.25(t, 1H, J=6.0 Hz); LCMS(M⁺ + H) 205.

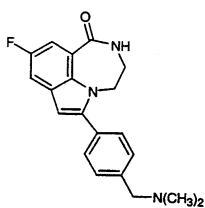
(f) 4 - (7 - - 5 - - 2,3,4,5 - - 1H - [e][1,4] - 9 -) - :

(84%); mp 228 - 230 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.29 - 3.32(m, 2H), 3.52 - 3.54(m, 2H), 6.31(t, 1H, J=6.0 Hz), 7.45(dd, 1H, J=9.0 Hz, J=3.0 Hz), 7.60(dd, 1H, J=9.0 Hz, 3.0 Hz), 7.88(d, 2H, J=9.0 Hz), 7.96(d, 2H, J=9.0 Hz), 8.31(t, 1H, J=6.0 Hz), 10.03(s, 1H); LCMS(M⁺ + H) 309.

(g) :

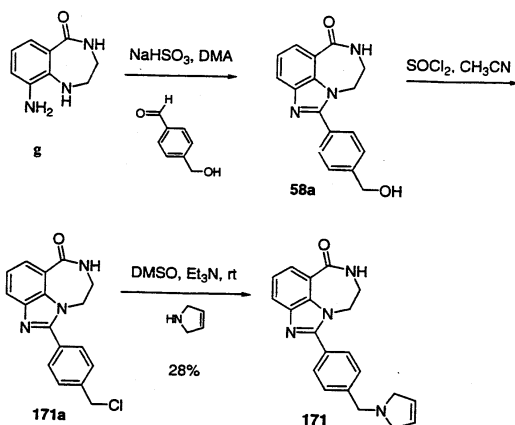
(85%); mp= 212 - 214 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.48 - 3.53(m, 2H), 4.36 - 4.39(m, 2H), 6.87(s, 1H), 7.58(dd, 1H, J=9.0, 3.0 Hz), 7.65(dd, 1H, J=9.0, 3.0 Hz), 7.86(d, 2H, J=9.0 Hz), 8.03(d, 2H, J=9.0 Hz), 8.58(t, 1H, J=6.0 Hz), 10.09(s, 1H); LCMS(M⁺ + H) 309.

170: 6 - (4 - -) - 9 - - 3,4 - - 2 HH - [1,4] [6,7,1 - hihi] - 1 -



4] , 82 , 4 - (9 - - 1 - - 1,2,3,4 - - [1, [6,7,1 - hi] - 6 -) - (169) , 91% : mp= 172 - 174 ; $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.18(s, 6H), 3.45(s, 2H), 3.47 - 3.52(m, 2H), 4.30 - 4.33(m, 2H), 6.69(s, 1H), 7.43(d, 2H, J=9.0 Hz), 7.51 - 7.61(m, 4H), 8.54(t, 1H, J=6.0 Hz); HRMS calcd. for C₂₀H₂₀N₃OF₁(M⁺) 337.1590, found(M⁺) 337.1580; Anal.(C₂₀H₂₀N₃OF) C, H, N.

171: 1 - [4 - (2,5 - - - 1 -) -] - 8,9 - - HH - 2,7,9a - - [c dcd] - 6 -



(58a) 1 - (4 -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - ,
 58a , 19 , g(2)
 4 - [- -]

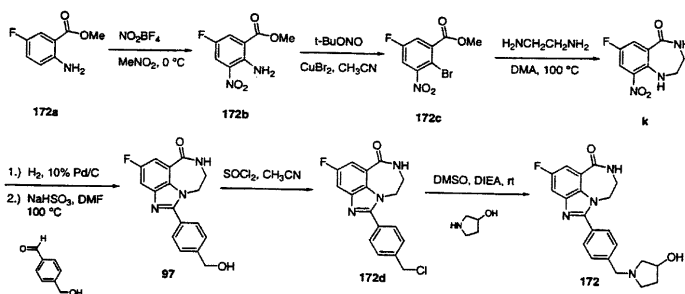
(171a) 1 - (4 -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -
 , 25M ℓ 58a 500mg (1.7mmol) 4
 . HPLC . HPLC R_t = 3.060min.

(171)

2M ℓ DMSO 171a 0.34mmol, 3 - 2.05mmol(6) 2.05
 mmol(6) 5 . (semi - p
 reparative) RP HPLC , 50% NaOH .
 EtOAc (5X), 36.2mg (28%) , HP
 LC , TFA .

¹H NMR(DMSO - d₆) 3.45 - 3.58(m, 6H), 3.88(s, 2H), 4.43 - 4.49(m, 2H), 5.83(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.53(d, 2H, J= 8.1 Hz), 7.81 - 7.90(m, 4H), 8.41(br s, 1H). HPLC Rt= 2.448 min. HRMS calcd fo r C₂₁ H₂₁ N₄ O 345.1715(M+H)⁺, found 345.1699. Anal.(C₂₁ H₂₀ N₄ O • 0.25EtOAc) C, H, N.

172: 4 - - 1 - [4 - (3 - - 1 -) -] - 8,9 - - 7 HH - 2,7,9a -
 - [cdcd] - 6 -



k(18) 97

(172b) 2 - - 5 - - 3 - -

250M \emptyset (Rodriguez, (4.75g, 35.8mmol), 3,949,081) (5.50g, 32.5mmol) 0 가 . TLC
(10 - 25% EtOAc/) , 5.05g(72%)

$^1\text{H NMR}$ (CDCl_3) 3.95(s, 3H), 8.04(dd, 1H, J= 8.4, 3.2 Hz), 8.15(dd, 1H, J= 8.4, 3.2 Hz), 8.32(br s, 2H). LRMS(m/z) 199(M - CH_3).

(172c) 2 - - 5 - - 3 - -
b' 2 , 2 - - 5 - - 3 -
, 4.02g(100%)

$^1\text{H NMR}$ ($\text{DMSO}-d_6$) 3.90(s, 3H), 7.99(dd, 1H, J= 8.3, 3.0 Hz), 8.30(dd, 1H, J= 7.7, 3.0 Hz). HPLC Rt= 4.384 min.

(k) 7 - - 9 - - 1,2,3,4 - [e][1,4] - 5 -
f 2 , 2 - - 5 - - 3 - -
, 2.20g(68%) 18

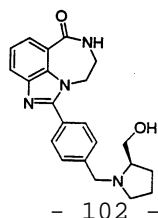
(97) 4 - - 1 - (-) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -
171 l(18) 4 -
- 1 - (-) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - 4 - -
97
172

(172d) 1 - (4 - -) - 4 - - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -
171 171a , 97
. HPLC R_t = 3.260min.

(172)
, Et_3N DIEA 171 , 17
2d , 73.3mg(43%)

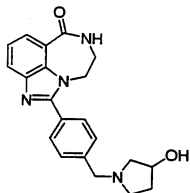
$^1\text{H NMR}$ ($\text{DMSO}-d_6$) 1.48 - 1.62(m, 1H), 1.98 - 2.05(m, 1H), 2.37 - 2.39(m, 1H), 2.48 - 2.53(m, 2H), 2.63 - 2.75(m, 2H), 3.54 - 3.74(m, 4H), 4.16 - 4.28(m, 1H), 4.36 - 4.51(m, 2H), 4.63 - 4.72(m, 1H), 7.51(d, 2H, J= 8.0 Hz), 7.59(dd, 1H, J= 10.6, 2.6 Hz), 7.72(dd, 1H, J= 10.6, 2.6 Hz), 7.81(d, 2H, J= 8.0 Hz), 8.54 - 8.58(m, 1H). HPLC Rt= 2.532 min. HRMS calcd for $\text{C}_{21}\text{H}_{22}\text{FN}_4\text{O}_2$ 381.1727(M+H)⁺, found 381.1717. Anal. ($\text{C}_{21}\text{H}_{21}\text{FN}_4\text{O}_2 \cdot 0.25\text{H}_2\text{O}$) C, H, N.

173: 1 - [4 - ((2R) - 2 - - 1 -) -] - 8,9 - - 7 HH - 2,7,9a -
- [cdcd] - 6 -



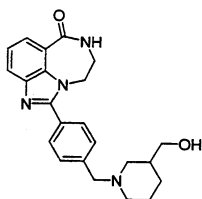
171, 171a, 54.3mg
 (41%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.53 - 1.95(m, 4H), 2.07 - 2.33(m, 1H), 2.55 - 2.93(m, 2H), 3.35 - 3.59(m, 5H), 4.10 - 4.31(m, 1H), 4.42 - 4.53(m, 3H), 7.35(t, 1H, J= 7.8 Hz), 7.56 - 7.71(m, 2H), 7.80 - 7.90(m, 4H), 8.40 - 8.43(m, 1H). HPLC Rt= 2.401 min. HRMS calcd for $\text{C}_{22}\text{H}_{25}\text{N}_4\text{O}_2$ 377.1977(M+H)⁺, found 377.1989. Anal. ($\text{C}_{22}\text{H}_{24}\text{N}_4\text{O}_2 \cdot 0.25\text{H}_2\text{O}$, 0.40 TFA) C, H, N.

174: 1 - [4 - (2 - - 1 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



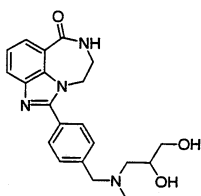
171, 171a, 26.1mg
 (21%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.55 - 1.59(m, 1H), 1.98 - 2.05(m, 1H), 2.35 - 2.39(m, 1H), 2.59 - 2.75(m, 3H), 3.47 - 3.59(m, 2H), 3.61 - 3.72(m, 2H), 4.19 - 4.26(m, 1H), 4.45(s, 2H), 4.69(s, 1H), 7.35 (t, 1H, J= 7.8 Hz), 7.50(d, 2H, J= 7.8 Hz), 7.80 - 7.90(m, 4H), 8.39 - 8.43(m, 1H). HPLC Rt= 2.281 min. HRMS calcd for $\text{C}_{21}\text{H}_{23}\text{N}_4\text{O}_2$ 363.1821(M+H)⁺, found 363.1831. Anal. ($\text{C}_{21}\text{H}_{22}\text{N}_4\text{O}_2 \cdot 0.25\text{H}_2\text{O}$) C, H, N.

175: 1 - [4 - (3 - - 1 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



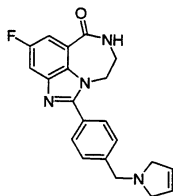
171, 171a, 57.3mg
 (43%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 0.82 - 0.98(m, 2H), 1.46 - 1.65(m, 5H), 1.82 - 2.12(m, 1H), 2.73 - 2.97(m, 2H), 3.16 - 3.32(m, 2H), 3.48 - 3.69(m, 3H), 4.33 - 4.57(m, 3H), 7.35(t, 1H, J= 7.8 Hz), 7.46 - 7.67(m, 2H), 7.78 - 7.96(m, 4H), 8.37 - 8.41(m, 1H). HPLC Rt= 2.496 min. HRMS calcd for $\text{C}_{23}\text{H}_{27}\text{N}_4\text{O}_2$ 391.2134(M+H)⁺, found 391.2140. Anal. ($\text{C}_{23}\text{H}_{26}\text{N}_4\text{O}_2 \cdot 0.25\text{H}_2\text{O}$) C, H, N.

176: 1 - (4 - {[(2,3 - -) - -] - } -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



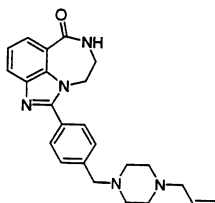
171, 171a, 36.2mg
 (28%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.2(s, 3H), 2.33-2.46(m, 1H), 3.42-3.42(m, 3H), 3.52-3.78(m, 5H), 4.33-4.57(m, 4H), 7.35(t, 1H, J= 7.8 Hz), 7.49-7.62(m, 2H), 7.78-7.90(m, 4H), 8.39-8.43(m, 1H). HPLC Rt= 2.247 min. HRMS calcd for $\text{C}_{21}\text{H}_{25}\text{N}_4\text{O}_3$ 381.1927(M+H)⁺, found 381.1916. Anal. ($\text{C}_{21}\text{H}_{24}\text{N}_4\text{O}_3 \cdot 0.25\text{H}_2\text{O}$, 0.10 TFA) C, H, N.

177: 1 - [4 - (2,5 - - - 1 -) -] - 4 - - 8,9 - - 7 HH - 2,7,9a -
 - [cdcd] - 6 -



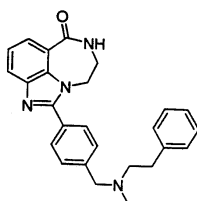
172, 172d, 50.7mg
 (31%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.46-3.64(m, 6H), (3.81-3.97(m, 2H), 4.41-1.62(m, 2H), 5.82(s, 2H), 7.52-7.62(m, 3H), 7.74(dd, 1H, J= 8.2, 2.6 Hz), 7.81(d, 2H, J= 8.1 Hz), 8.55-8.58(m, 1H). HPLC Rt= 3.182 min. HRMS calcd for $\text{C}_{21}\text{H}_{20}\text{FN}_4\text{O}$ 363.1621(M+H)⁺, found 363.1624. Anal. ($\text{C}_{21}\text{H}_{19}\text{FN}_4\text{O} \cdot 0.25\text{H}_2\text{O}$) C, H, N.

178: 1 - [4 - (4 - - - 1 -) -] - 2,7,8,9 - - 2,7,9a - - [cd
 cd] - 6 -



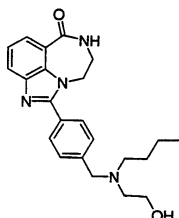
171, 171a, 65.8mg
 (48%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.27-2.53(m, 4H), 2.72-3.05(m, 4H), 3.22-3.35(m, 2H), 3.48-3.58(m, 2H), 3.62-3.71(m, 2H), 4.42-4.59(m, 2H), 5.36-5.52(m, 2H), 5.78-5.92(m, 1H), 7.36(t, 1H, J= 7.8 Hz), 7.48-7.58(m, 2H), 7.83-7.90(m, 4H), 8.41-8.45(m, 1H). HPLC Rt= 2.506 min. HRMS calcd for $\text{C}_{24}\text{H}_{28}\text{N}_4\text{O}$ 402.2294(M+H)⁺, found 402.2288. Anal. ($\text{C}_{24}\text{H}_{27}\text{N}_4\text{O} \cdot 0.80\text{TFA}$) C, H, N.

179: 1 - {4 - [(- -) -] - } - 2,7,8,9 - - 2,7,9a - - [cd
 cd] - 6 - AG - 014536



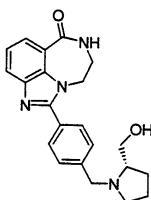
171, 171a, 47.0mg
 (34%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.65 - 3.15(m, 4H), 3.27 - 3.38(m, 5H), 3.55 - 3.64(m, 2H), 3.62 - 3.71(m, 2H), 4.42 - 4.59(m, 2H), 7.23 - 7.47(m, 6H), 7.89 - 8.06(m, 4H), 8.45 - 8.53(m, 1H). HPLC Rt= 3.075 min. HRMS calcd for $\text{C}_{26}\text{H}_{27}\text{N}_4\text{O}$ 411.2185(M+H)⁺, found 411.2188. Anal. ($\text{C}_{26}\text{H}_{26}\text{N}_4\text{O} \cdot 0.60 \text{ TFA}$) C, H, N.

180: 1 - [4 - { [(2 -) -] - } -] - 2,7,8,9 - - 2,7,9a -
 - [cdcd] - 6 -



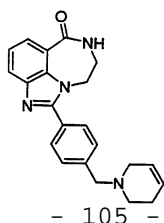
171, 171a, 32.3mg
 (24%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 0.81 - 0.94(m, 3H), 1.16 - 1.79(m, 5H), 2.97 - 3.37(m, 4H), 3.46 - 3.83(m, 4H), 4.24 - 4.58(m, 4H), 7.31 - 7.40(m, 1H), 7.46 - 7.66(m, 2H), 7.77 - 7.99(m, 4H), 8.37 - 8.46 (m, 1H). HPLC Rt= 2.646 min. HRMS calcd for $\text{C}_{23}\text{H}_{29}\text{N}_4\text{O}$ 393.2290(M+H)⁺, found 393.2288. Anal. ($\text{C}_{23}\text{H}_{28}\text{N}_4\text{O} \cdot 0.60 \text{ TFA}$) C, H, N.

181: 1 - [4 - ((2S) - 2 - - 1 -) -] - 2,7,8,9 - - 2,7,9a -
 - [cdcd] - 6 -



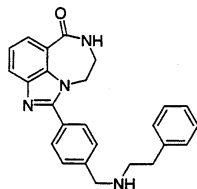
171, 171a, 31.9mg
 (25%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.71 - 2.20(m, 4H), 3.13 - 3.29(m, 2H), 3.51 - 3.66(m, 5H), 4.32 - 4.51(m, 3H), 4.58 - 4.71(m, 1H), 5.49 - 5.58(m, 1H), 7.37(t, 1H, J= 7.8 Hz), 7.68 - 7.78(m, 2H), 7.86 - 7.99(m, 4H), 8.42 - 8.48(m, 1H). HPLC Rt= 2.443 min. HRMS calcd for $\text{C}_{22}\text{H}_{25}\text{N}_4\text{O}_2$ 377.1977(M+H)⁺, found 377.1993. Anal. ($\text{C}_{22}\text{H}_{24}\text{N}_4\text{O}_2 \cdot 1.0 \text{ TFA}$) C, H, N.

182: 1 - [4 - (3,6 - - 2 HH - - 1 -) -] - 2,7,8,9 - - 2,7,9a -
 - [cdcd] - 6 -



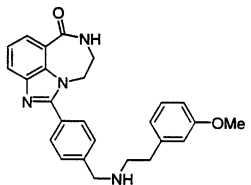
171, 171a, 48mg(39%)가 : ¹H NMR(DMSO - d₆) 2.14 - 2.45(m, 2H), 2.95 - 3.21(m, 2H), 3.43 - 3.82(m, 4H), 4.17 - 4.63(m, 4H), 5.61 - 5.78(m, 1H), 5.81 - 6.06(m, 1H), 7.37(t, 1H, J= 7.8 Hz), 7.62 - 7.76(m, 2H), 7.86 - 7.99(m, 4H), 8.41 - 8.48(m, 1H). HPLC Rt= 2.610 min. HRMS calcd for C₂₂H₂₃N₄O 359.1872(M+H)⁺, found 359.1886. Anal.(C₂₂H₂₂N₄O • 0.85 TFA) C, H, N.

183: 1 - [4 - (-) -] - 2,7,8,9 - - 2,7,9a - - [cdcd] - 6 -



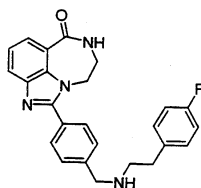
171, 171a, 188mg(59%)가 : ¹H NMR(DMSO - d₆) 2.83 - 2.96(m, 2H), 3.09 - 3.20(m, 2H), 3.41 - 3.49(m, 2H), 4.28 - 4.37(m, 2H), 4.41 - 4.52(m, 3H), 7.12 - 7.33(m, 6H), 7.60 - 7.76(m, 2H), 7.79 - 7.89(m, 4H), 8.33 - 8.41(m, 1H). HPLC Rt= 2.907 min. HRMS calcd for C₂₅H₂₅N₄O 397.2028(M+H)⁺, found 397.2018. Anal.(C₂₅H₂₄N₄O • 2.0 TFA) C, H, N.

184: 1 - (4 - {2 - (3 - -) - } -) - 2,7,8,9 - - 2,7,9a - - [cdcd] - 6 -



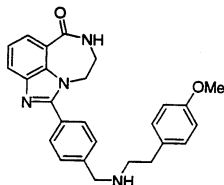
171, 171a, 148.7mg(45%)가 : ¹H NMR(DMSO - d₆) 1.91 - 1.98(m, 2H), 2.91 - 2.28(m, 2H), 3.52 - 3.61(m, 2H), 3.73(s, 3H), 4.30 - 4.38(m, 2H), 4.43 - 4.50(m, 2H), 6.80 - 6.89(m, 4H), 7.25(t, 1H, J= 7.7 Hz), 7.36(t, 1H, J= 7.8 Hz), 7.67(d, 2H, J= 7.8 Hz), 8.84 - 8.98(m, 4H), 8.48(br s, 1H). HPLC Rt= 2.970 min. HRMS calcd for C₂₆H₂₇N₄O₂ 427.2134(M+H)⁺, found 427.2117. Anal.(C₂₆H₂₆N₄O₂ • 2.0 TFA) C, H, N.

185: 1 - (4 - {[2 - (4 - -) - } - } -) - 2,7,8,9 - - 2,7,9a - - [cdcd] - 6 -



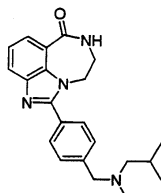
171, 171a, 132mg
 (45%)가 : $^1\text{H NMR}$ (DMSO - d_6) 3.02 - 3.08(m, 2H), 3.23 - 3.33(m, 2H), 3.58 - 3.66(m, 2H), 4.34 - 4.45(m, 3H), 4.51 - 4.59(m, 2H), 7.22(t, 1H, $J = 7.7$ Hz), 7.33 - 7.48(m, 4H), 7.74(d, 2H, $J = 7.7$ Hz), 8.93 - 8.07(m, 4H), 8.53(br s, 1H). HPLC Rt = 3.000 min. HRMS calcd for $^{25}\text{H}_{24}\text{FN}_4\text{O}$ 415.1934(M+H) $^+$, found 415.1914. Anal.($\text{C}_{25}\text{H}_{23}\text{FN}_4\text{O} \cdot 1.6$ TFA) C, H, N.

186: 1 - (4 - { [2 - (4 - -) -] - } -) - 2,7,8,9 - - 2,7,9a -
 - [cdcd] - 6 -



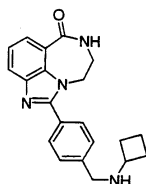
171, 171a, 163.7 mg(49%)가 : $^1\text{H NMR}$ (DMSO - d_6) 3.04 - 3.13(m, 2H), 3.28 - 3.42(m, 2H), 3.61 - 3.77(m, 2H), 3.88(s, 3H), 4.45 - 4.52(m, 3H), 4.61 - 4.72(m, 2H), 7.11(d, 2H, $J = 7.7$ Hz), 7.35(d, 2H, $J = 7.7$ Hz), 7.54(t, 1H, $J = 7.7$ Hz), 7.87(d, 2H, $J = 7.7$ Hz), 8.06 - 8.17(m, 4H), 8.63(br s, 1H). HPLC Rt = 2.970 min. HRMS calcd for $\text{C}_{26}\text{H}_{27}\text{N}_4\text{O}_2$ 427.2134(M+H) $^+$, found 427.2117. Anal.($\text{C}_{26}\text{H}_{26}\text{N}_4\text{O}_2 \cdot 2.0$ TFA) C, H, N.

187: 1 - { 4 - [(- -) -] - } - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



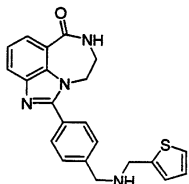
171, 171a, 64.7mg (26%)가 : $^1\text{H NMR}$ (DMSO - d_6) 0.88 - 1.01(m, 6H), 1.81 - 1.98(m, 1H), 2.73 - 2.84(m, 3H), 2.85 - 3.02(m, 2H), 3.51 - 3.63(m, 2H), 4.32 - 4.55(m, 4H), 7.37(t, 1H, $J = 7.7$ Hz), 7.73(d, 2H, $J = 7.7$ Hz), 7.96 - 8.14(m, 4H), 8.43(br s, 1H). HPLC Rt = 2.167 min. HRMS calcd for $\text{C}_{22}\text{H}_{27}\text{N}_4\text{O}$ 363.2185(M+H) $^+$, found 363.2180. Anal.($\text{C}_{22}\text{H}_{26}\text{N}_4\text{O} \cdot 0.75$ H_2O , 1.0 TFA) C, H, N.

188: 1 - (4 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



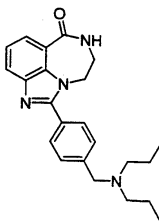
171, 171a, 58mg(21%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.71 - 1.89(m, 2H), 2.08 - 2.24(m, 4H), 3.51 - 3.62(m, 2H), 3.67 - 3.79(m, 1H), 4.12 - 4.18(m, 2H), 4.39 - 4.50(m, 2H), 7.37(t, 1H, J= 7.7 Hz), 7.68(d, 2H, J= 7.7 Hz), 7.87 - 7.96(m, 4H), 8.43(br s, 1H). HPLC Rt= 2.531 min. HRMS calcd for $\text{C}_{22}\text{H}_{27}\text{N}_4\text{O}$ 363.2185(M+H) $^+$, found 363.2180. Anal. ($\text{C}_{22}\text{H}_{26}\text{N}_4\text{O} \cdot 0.75\text{H}_2\text{O}, 1.0\text{TFA}$) C, H, N.

189: 1 - (4 - {[(- 2 -) -] - } -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



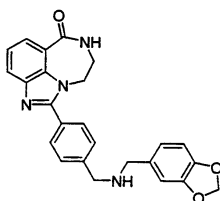
171, 171a, 63.2mg(20%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.51 - 3.59(m, 2H), 4.24 - 4.32(m, 3H), 4.42 - 4.51(m, 4H), 7.11 - 7.13(m, 1H), 7.28 - 7.44(m, 2H), 7.66 - 7.70(m, 3H), 7.78 - 7.96(m, 4H), 8.46(br s, 1H). HPLC Rt= 2.686 min. LRMS(m/z) 389(M+H). Anal. ($\text{C}_{22}\text{H}_{20}\text{N}_4\text{OS} \cdot 2.0\text{TFA}$) C, H, N.

190: 1 - (4 - (-) -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



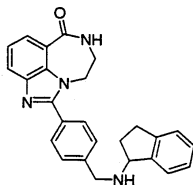
171, 171a, 56.3mg(17%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 0.90(t, 6H, J= 7.5 Hz), 1.67 - 1.77(m, 4H), 2.95 - 3.07(m, 4H), 3.52 - 3.62(m, 2H), 4.41 - 4.51(m, 4H), 7.39(t, 1H, J= 7.8 Hz), 7.73(d, 2H, J= 8.1 Hz), 7.89 - 7.92(m, 2H), 7.98(d, 2H, J= 8.1 Hz), 8.46(br s, 1H). HPLC Rt= 2.844 min. HRMS calcd for $\text{C}_{23}\text{H}_{29}\text{N}_4\text{O}$ 377.2341(M+H) $^+$, found 377.2336. Anal. ($\text{C}_{23}\text{H}_{28}\text{N}_4\text{O} \cdot 0.58\text{H}_2\text{O}, 2.0\text{TFA}$) C, H, N.

191: 1 - (4 - {[[1,3] - 5 -) -] - } -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



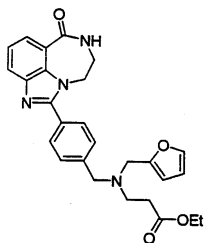
171, 171a, 154.8 mg(15%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.51 - 3.59(m, 2H), 4.11 - 4.18(m, 2H), 4.22 - 4.31(m, 3H), 4.43 - 4.50(m, 2H), 6.06(s, 2H), 6.99(s, 2H), 7.09(s, 1H), 7.39(t, 1H, J = 7.8 Hz), 7.67(d, 2H, J = 8.2 Hz), 7.89 - 7.96(m, 4H), 8.47(br s, 1H). HPLC Rt = 2.839 min. HRMS calcd for $\text{C}_{25}\text{H}_{23}\text{N}_4\text{O}_3$ 477.1770(M+H)⁺, found 477.1770. Anal. (C₂₅H₂₂N₄O₃ · 2.25 TFA) C, H, N.

192: 1 - [4 - (- 1 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



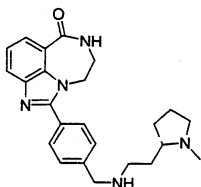
171, 171a, 75mg(24%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.14 - 2.24(m, 1H), 2.34 - 2.42(m, 1H), 2.74 - 2.84(m, 1H), 2.97 - 3.07(m, 1H), 3.36 - 3.46(m, 2H), 4.19 - 4.36(m, 5H), 4.69 - 4.81(m, 1H), 7.16 - 7.27(m, 4H), 7.53 - 7.60(m, 3H), 7.74 - 7.83(m, 4H), 8.33(br s, 1H). HPLC Rt = 2.927 min. HRMS calcd for $\text{C}_{26}\text{H}_{25}\text{N}_4\text{O}$ 409.2028(M+H)⁺, found 409.2030. Anal. (C₂₆H₂₄N₄O · 1.9 TFA) C, H, N.

193: 3 - { [4 - (6 - - 6,7,8,9 - - 2,7,9a - - [cdcd] - 1 -) -] - 2 - - } -



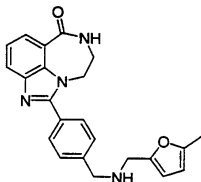
171, 171a, 55.6mg(16%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.17(t, 3H, J = 6.9 Hz), 2.53 - 2.77(m, 2H), 2.93 - 3.13(m, 2H), 3.51 - 3.59(m, 2H), 4.06(q, 2H, J = 8.1 Hz), 4.15 - 4.47(m, 6H), 6.53 - 6.66(m, 2H), 7.37 - 7.42(m, 1H), 7.67 - 7.92(m, 7H) 8.45(br s, 1H). HPLC Rt = 3.008 min. HRMS calcd for $\text{C}_{27}\text{H}_{29}\text{N}_4\text{O}_4$ 473.2189(M+H)⁺, found 473.2208. Anal. (C₂₇H₂₈N₄O₄ · 1.75 TFA) C, H, N.

194: 1 - (4 - { [2 - (1 - - 2 -) -] - } -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



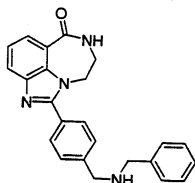
171, 171a, 57.9mg
 (15%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.53 - 1.69(m, 2H), 1.80 - 2.07(m, 4H), 2.18 - 2.34(m, 2H), 2.82 (s, 3H), 2.97 - 3.13(m, 2H), 3.24 - 3.38(m, 1H), 3.50 - 3.64(m, 3H), 4.23 - 4.34(m, 2H), 4.41 - 4.58(m, 2H), 7.39(t, 1H, J = 7.8 Hz), 7.81(d, 2H, J = 8.2 Hz), 7.89 - 8.02(m, 4H), 8.47(br s, 1H). HPLC Rt = 2.351 min. HRMS calcd for $\text{C}_{24}\text{H}_{30}\text{N}_5\text{O}$ 404.2450(M+H)⁺, found 404.2456. Anal. ($\text{C}_{24}\text{H}_{29}\text{N}_5\text{O} \cdot 3.25 \text{ TFA}$) C, H, N.

195: 1 - [4 - ((5 - - 2 -) -] - } -) - 8,9 - - 7 HH - 2,7,9a -
 - [cdcd] - 6 -



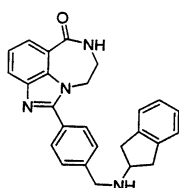
171, 171a, 64.7mg
 (24%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.30(s, 3H), 3.49 - 3.59(m, 3H), 4.19 - 4.33(m, 4H), 4.41 - 4.51(m, 2H), 6.15(m, 1H), 6.51(m, 1H), 7.37(t, 1H, J = 7.8 Hz), 7.68(d, 2H, J = 8.1 Hz), 7.88 - 7.95(m, 4H), 8.46(br s, 1H). HPLC Rt = 2.713 min. HRMS calcd for $\text{C}_{23}\text{H}_{23}\text{N}_4\text{O}_2$ 387.1821(M+H)⁺, found 387.1817. Anal. ($\text{C}_{23}\text{H}_{22}\text{N}_4\text{O}_2 \cdot 1.25 \text{ TFA}$) C, H, N.

196: 1 - [4 - (() -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



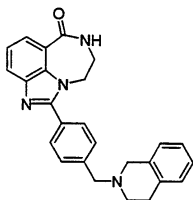
171, 171a, 73.9mg
 (26%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.51 - 3.59(m, 2H), 4.20 - 4.27(m, 3H), 4.28 - 4.35(m, 2H), 4.47 - 4.50(m, 2H), 7.38(t, 1H, J = 7.8 Hz), 7.43 - 7.53(m, 5H), 7.70(d, 2H, J = 8.3 Hz), 7.89 - 7.96(m, 4H), 8.46(br s, 1H). HPLC Rt = 2.470 min. HRMS calcd for $\text{C}_{24}\text{H}_{23}\text{N}_4\text{O}$ 383.1866(M+H)⁺, found 383.1883. Anal. ($\text{C}_{24}\text{H}_{22}\text{N}_4\text{O} \cdot 0.5 \text{ H}_2\text{O}, 1.5 \text{ TFA}$) C, H, N.

197: 1 - [4 - (- 2 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



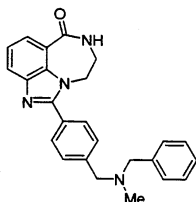
171, 171a, 138.9
 mg(43%)가 : $^1\text{H NMR}$ (DMSO - d_6) 3.13 - 3.21(m, 2H), 3.33 - 3.42(m, 2H), 3.52 - 3.59(m, 2H), 4.05 - 4.17(m, 2H), 4.34 - 4.41(m, 2H), 4.43 - 4.50(m, 2H), 7.20 - 7.31(m, 4H), 7.38(t, 1H, $J = 7.8$ Hz), 7.74(d, 2H, $J = 8.3$ Hz), 7.88 - 7.93(m, 2H), 7.97(d, 2H, $J = 8.3$ Hz), 8.47(br s, 1H). HPLC Rt = 2.554 min. HRMS calcd for $\text{C}_{26}\text{H}_{25}\text{N}_4\text{O}$ 409.2023($\text{M} + \text{H}$) $^+$, found 409.2034. Anal. ($\text{C}_{26}\text{H}_{24}\text{N}_4\text{O} \cdot 2.0$ TFA) C, H, N.

198: 1 - [4 - (3,4 - - 1 HH - - 2 -) -] - 8,9 - - 7HH - 2,7,9a -
 - [cdcd] - 6 -



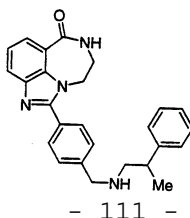
171, 171a, 142.4
 mg(44%)가 : $^1\text{H NMR}$ (DMSO - d_6) 3.09 - 3.17(m, 2H), 3.33 - 3.46(m, 1H), 3.51 - 3.60(m, 2H), 3.67 - 3.79(m, 1H), 4.37 - 4.44(m, 2H), 4.47 - 4.54(m, 2H), 4.55 - 4.63(m, 2H), 7.21 - 7.31(m, 4H), 7.39(t, 1H, $J = 7.8$ Hz), 7.77(d, 2H, $J = 8.2$ Hz), 7.89 - 7.94(m, 2H), 7.99(d, 2H, $J = 8.2$ Hz), 8.47(br s, 1H). HPLC Rt = 2.336 min. HRMS calcd for $\text{C}_{26}\text{H}_{25}\text{N}_4\text{O}$ 409.2023($\text{M} + \text{H}$) $^+$, found 409.2015. Anal. ($\text{C}_{26}\text{H}_{24}\text{N}_4\text{O} \cdot 2.0$ TFA) C, H, N.

199: 1 - [4 - (- - -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



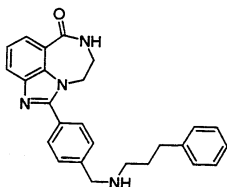
171, 171a, 197.6
 mg(62%)가 : $^1\text{H NMR}$ (DMSO - d_6) 2.61(s, 3H), 3.52 - 3.59(m, 2H), 4.22 - 4.40(m, 2H), 4.45 - 4.62(m, 4H), 7.39(t, 1H, $J = 7.8$ Hz), 7.43 - 7.56(m, 5H), 7.73(d, 2H, $J = 8.2$ Hz), 7.89 - 7.93(m, 2H), 7.97(d, 2H, $J = 8.2$ Hz), 8.47(br s, 1H). HPLC Rt = 2.333 min. HRMS calcd for $\text{C}_{25}\text{H}_{25}\text{N}_4\text{O}$ 397.2023($\text{M} + \text{H}$) $^+$, found 397.2035. Anal. ($\text{C}_{25}\text{H}_{24}\text{N}_4\text{O} \cdot 0.25$ H_2O , 2.0 TFA) C, H, N.

200: 1 - {4 - [(2 - - -) -] - } - 8,9 - - 7 HH - 2,7,9a - - [cdc
 d] - 6 -



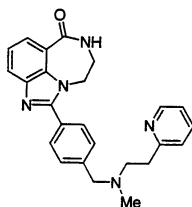
171, 171a, 108.2
 mg(33%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.28(s, 3H), 3.14 - 3.24(m, 3H), 3.51 - 3.59(m, 2H), 4.22 - 4.30(m, 2H), 4.42 - 4.50(m, 3H), 7.25 - 7.41(m, 6H), 7.68(d, 2H, J = 8.3 Hz), 7.88 - 7.96(m, 4H), 8.47(br s, 1H). HPLC Rt = 2.248 min. HRMS calcd for $\text{C}_{26}\text{H}_{27}\text{N}_4\text{O}$ 411.2179(M+H)⁺, found 411.2193. Anal. ($\text{C}_{26}\text{H}_{26}\text{N}_4\text{O} \cdot 2.0 \text{ TFA}$) C, H, N.

201: 1 - { 4 - [(3 - -) -] - } - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



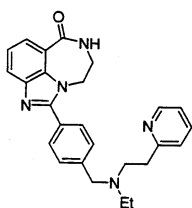
171, 171a, 73.2mg
 (22%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.90 - 2.00(m, 2H), 2.64 - 2.69(m, 2H), 2.93 - 3.05(m, 2H), 3.50 - 3.60(m, 2H), 4.25 - 4.31(m, 2H), 4.40 - 4.51(m, 3H), 7.18 - 7.36(m, 5H), 7.39(t, 1H, J = 7.9 Hz), 7.68(d, 2H, J = 8.2 Hz), 7.88 - 7.96(m, 4H), 8.47(br s, 1H). HPLC Rt = 3.092 min. HRMS calcd for $\text{C}_{26}\text{H}_{26}\text{N}_4\text{O}$ 411.2179(M+H)⁺, found 411.2186. Anal. ($\text{C}_{26}\text{H}_{26}\text{N}_4\text{O} \cdot 2.0 \text{ TFA}$) C, H, N.

202: 1 - (4 - { [- (2 - - 2 - -) -] - } -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



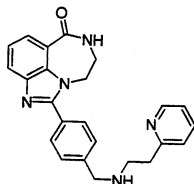
171, 171a, 16.2mg
 (6%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.51(s, 3H), 3.27 - 3.46(m, 4H), 3.55 - 3.67(m, 2H), 4.01 - 4.13(m, 2H), 4.48 - 4.59(m, 2H), 7.37 - 7.49(m, 2H), 7.54 - 7.75(m, 3H), 7.84 - 8.11(m, 6H), 8.50(br s, 1H). HPLC Rt = 2.174 min. HRMS calcd for $\text{C}_{25}\text{H}_{26}\text{N}_5\text{O}$ 412.2132(M+H)⁺, found 412.2139. Anal. ($\text{C}_{25}\text{H}_{25}\text{N}_5\text{O} \cdot 1.0 \text{ H}_2\text{O}, 3.0 \text{ TFA}$) C, H, N.

203: 1 - (4 - { [- (2 - - 2 - -) -] - } -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



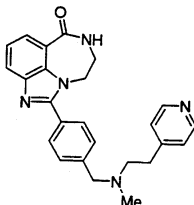
171, 171a, 14mg(4%)가 : $^1\text{H NMR}$ (DMSO- d_6) 1.06 - 1.23(m, 3H), 2.62 - 2.79(m, 4H), 3.53 - 3.67(m, 4H), 3.87 - 3.98(m, 2H), 4.46 - 4.58(m, 2H), 7.35 - 7.46(m, 2H), 7.55 - 7.67(m, 3H), 7.82 - 8.00(m, 6H), 8.48(br s, 1H). HPLC Rt= 2.214 min. HRMS calcd for $\text{C}_{26}\text{H}_{28}\text{N}_5\text{O}$ 426.2288(M+H) $^+$, found 426.2285. Anal.($\text{C}_{26}\text{H}_{27}\text{N}_5\text{O} \cdot 0.5\text{H}_2\text{O}$, 3.0 TFA) C, H, N.

204: 1 - { 4 - [(2 - 2 -) -] - } - 8,9 - 7 HH - 2,7,9a - [cdcd] - 6 -



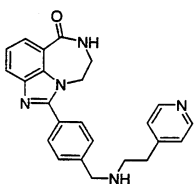
171, 171a, 15.8mg(5%)가 : $^1\text{H NMR}$ (DMSO- d_6) 3.13 - 3.21(m, 2H), 3.34 - 3.44(m, 2H), 3.51 - 3.59(m, 2H), 4.32 - 4.39(m, 3H), 4.44 - 4.49(m, 2H), 7.30 - 7.42(m, 3H), 7.59(d, 2H, J= 8.2 Hz), 7.67 - 7.83(m, 1H), 7.89 - 7.98(m, 4H), 8.47(br s, 1H), 8.54(s, 1H). HPLC Rt= 2.506 min. HRMS calcd for $\text{C}_{24}\text{H}_{24}\text{N}_5\text{O}$ 398.1975(M+H) $^+$, found 398.1969. Anal.($\text{C}_{24}\text{H}_{23}\text{N}_5\text{O} \cdot 0.5\text{H}_2\text{O}$, 2.25 TFA) C, H, N.

205: 1 - (4 - { [(2 - 4 -) -] - } -) - 8,9 - 7 HH - 2,7,9a - [cdcd] - 6 -



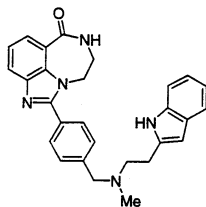
171, 171a, 5.4mg(5%)가 : $^1\text{H NMR}$ (DMSO- d_6) 2.93 - 3.23(m, 3H), 3.24 - 3.87(m, 8H), 3.88 - 4.15(m, 2H), 4.44 - 4.49(m, 2H), 7.06 - 8.01(m, 9H), 8.54(br s, 1H). HPLC Rt= 2.275 min. HRMS calcd for $\text{C}_{25}\text{H}_{26}\text{N}_5\text{O}$ 412.2132(M+H) $^+$, found 412.2124. Anal.($\text{C}_{25}\text{H}_{25}\text{N}_5\text{O} \cdot 0.5\text{H}_2\text{O}$, 3.5 TFA) C, H, N.

206: 1 - { 4 - [(2 - 4 -) -] - } - 8,9 - 7 HH - 2,7,9a - [cdcd] - 6 -



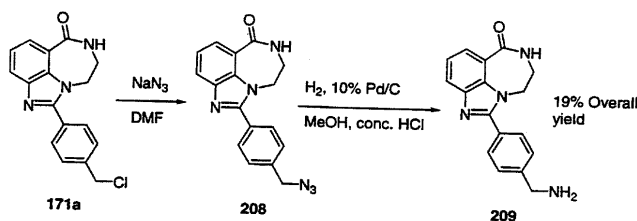
171, 171a, 11.6mg
 (3%)가 : $^1\text{H NMR}$ (DMSO- d_6) 2.75 - 2.89(m, 4H), 3.48 - 3.57(m, 3H), 3.84 - 3.89(m, 2H), 4.41 - 4.50(m, 2H), 7.24 - 7.27(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.52(d, 2H, J= 8.1 Hz), 7.81(d, 2H, J= 8.1 Hz), 7.87(t, 2H, J= 7.6 Hz), 8.38 - 8.48(m, 3H). HPLC Rt= 2.346 min. HRMS calcd for $\text{C}_{24}\text{H}_{24}\text{N}_5\text{O}$ 398.1975 found 398.1969. Anal. ($\text{C}_{24}\text{H}_{23}\text{N}_5\text{O} \cdot 0.75\text{H}_2\text{O}, 3.25\text{TFA}$) C, H, N.

207: 1 - [4 - ({ [2 - (1 HH - 2 -) -] - } -) -] - 8,9 - - 7HH - 2,7,9a - [cdcd] - 6 -



171, 171a, 18.8mg
 (5%)가 : $^1\text{H NMR}$ (DMSO- d_6) 2.32(s, 3H), 2.64 - 2.78(m, 2H), 2.88 - 2.97(m, 2H), 3.49 - 3.57(m, 2H), 3.63 - 3.75(m, 2H), 4.42 - 4.49(m, 2H), 6.93(t, 1H, J= 6.9 Hz), 7.04(t, 1H, J= 7.1 Hz), 7.14(s, 1H), 7.31(d, 1H, J= 7.2 Hz), 7.31(d, 1H, J= 7.2 Hz), 7.36(d, 1H, J= 7.8 Hz), 7.45(d, 1H, J= 7.8 Hz), 7.49 - 7.55(m, 2H), 7.78 - 7.83(m, 2H), 7.88(t, 2H, J= 8.6 Hz), 8.41(br s, 1H). HPLC Rt= 3.170 min. HRMS calcd for $\text{C}_{28}\text{H}_{28}\text{N}_5\text{O}$ 450.2288(M+H) $^+$, found 450.2279. Anal. ($\text{C}_{28}\text{H}_{27}\text{N}_5\text{O} \cdot 1.0\text{H}_2\text{O}, 2.5\text{TFA}$) C, H, N.

208 - 209: 1 - (4 -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



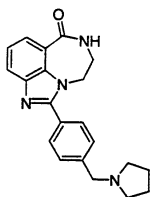
(208) 1 - (4 -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -

1 - (4 -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - (0.24g, 0.77mmol),
 (0.050g, 0.77mmol) DMF(8M ℓ) 3
 가 : IR(KBr) 3204, 3096, 2229, 1654, 1600, 1603, 1319, 1139 cm^{-1} , $^1\text{H NMR}$ (DMSO- d_6) 3.50 - 3.58(m, 2H), 4.43 - 4.50(m, 2H), 4.59(s, 2H), 7.36(t, 1H, J= 7.9 Hz), 7.58(d, 2H, J= 8.2 Hz), 7.86 - 7.94(m, 4H), 8.44(br s, 1H). HPLC Rt= 3.059min.

(209)

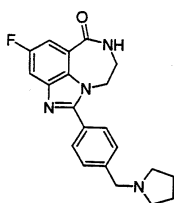
1 - (4 -) - 8,9 - - 7H - 2,7,9a - - [cd]
 - 6 - 9:1 CH₃ OH/HCl() 10Mℓ , 200mg 10% Pd/C H₂ (60psi)
 (Parr shaker) . 2 , Celite ,
 RP - HPLC (prep RP - HPLC) , 49.0mg (19%) : ¹H NMR(DMSO - d₆) 3.46 - 3.54(m,
 2H), 4.06 - 4.15(m, 2H), 4.36 - 4.43(m, 2H), 7.32(t, 1H, J= 7.5 Hz), 7.60(d, 2H, J= 8.2 Hz), 7.81 - 7.90(m,
 4H), 8.17(br s, 2H), 8.40(br s, 1H). HPLC Rt= 2.109 min. HRMS calcd for C₁₇ H₁₇ N₄ O 293.1406(M+H)
 + , found 293.1397. Anal.(C₁₇ H₁₆ N₄ O · 0.5 H₂O, 1.75 TFA) C, H, N.

210: 1 - (4 - - 1 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



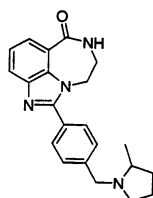
171 , 171a , 145.0
 mg(41%)가 :¹H NMR(DMSO - d₆) 1.69 - 1.76(m, 4H), 2.50 - 2.55(m, 4H), 3.50 - 3.56(m, 2H), 3.
 67 - 3.72(m, 2H), 4.43 - 4.48(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.51(d, 2H, J= 8.1 Hz), 7.81(d, 2H, J= 8.1 H
 z), 7.85 - 7.91(m, 2H), 8.41(br s, 1H). HPLC Rt= 2.501 min. HRMS calcd for C₂₁ H₂₃ N₄ O 347.1866(M+H)
 + , found 347.1877. Anal.(C₂₁ H₂₂ N₄ O · 0.25 EtOAc) C, H, N.

211: 4 - - 1 - (4 - - 1 - -) - 8,9 - - 7 HH - 2,7,9a - - [cd
 cd] - 6 -



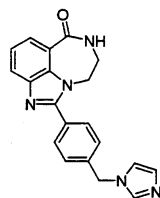
172 , 172d , 180.0
 mg(47%)가 :¹H NMR(DMSO - d₆) 1.69 - 1.75(m, 4H), 2.44 - 2.48(m, 4H), 3.51 - 3.58(m, 2H), 3.
 66 - 3.69(m, 2H), 4.43 - 4.48(m, 2H), 7.51(d, 2H, J= 8.2 Hz), 7.59(dd, 1H, J= 10.7, 2.6 Hz), 7.74(dd, 1H,
 J= 9.0, 2.6 Hz), 7.80(d, 2H, J= 8.2 Hz), 8.57(br s, 1H). HPLC Rt= 2.560 min. HRMS calcd for C₂₁ H₂₂ FN
 4 O 365.1772(M+H) + , found 365.1759. Anal.(C₂₁ H₂₁ FN₄ O · 0.1 EtOAc) C, H, N.

212: 1 - [4 - (2 - - 1 - -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd
] - 6 -



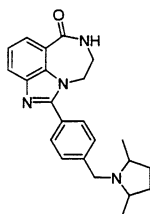
171, 171a, 155.7
 mg(67%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.12(d, 3H, J= 6 Hz), 1.33 - 1.39(m, 1H), 1.58 - 1.65(m, 1H),
 1.90 - 1.96(m, 2H), 2.06 - 2.11(m, 1H), 2.41 - 2.53(m, 1H), 2.80 - 2.86(m, 1H), 3.24(d, 1H, J= 13.5 Hz), 3.
 50 - 3.57(m, 2H), 4.05(d, 1H, J= 13.5 Hz), 4.43 - 4.49(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.49(d, 2H, J= 8.1
 Hz), 7.80(d, 2H, J= 8.1 Hz), 7.85 - 7.90(m, 2H), 8.41(br s, 1H). HPLC Rt= 2.622 min. LRMS(m/z) 361(M
 +H). Anal. ($\text{C}_{22}\text{H}_{24}\text{N}_4\text{O}$) C, H, N.

213: 1 - (4 - - 1 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



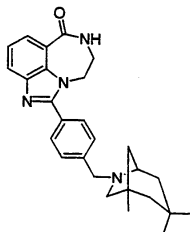
171, 171a, 141mg
 (26%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.48 - 3.57(m, 2H), 3.40 - 4.48(m, 2H), 5.55(s, 2H), 7.38(t, 1H,
 J= 7.8 Hz), 7.61(d, 2H, J= 8.1 Hz), 7.72(m, 1H), 7.85(m, 1H), 7.88 - 7.93(m, 4H), 8.45(t, 1H, J= 5.5 Hz),
 9.29(s, 1H). HPLC Rt= 2.410 min. HRMS calcd for $\text{C}_{20}\text{H}_{18}\text{N}_5\text{O}$ 344.1506(M+H)⁺, found 344.1517. Anal.
 ($\text{C}_{20}\text{H}_{17}\text{N}_5\text{O} \cdot 2.0 \text{ TFA}$) C, H, N.

214: 1 - [4 - (2,5 - - 1 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



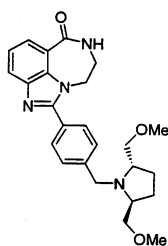
171, 171a, 153.7
 mg(43%)가 : $^1\text{H NMR}$ (DMSO - d_6) 0.98(s, 3H), 1.00(s, 3H), 1.28 - 1.37(m, 2H), 1.77 - 1.85(m, 2H), 2.54 - 2.73(m, 2H), 3.49 - 3.56(m, 2H), 3.76(s, 2H), 4.42 - 4.48(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.51(d, 2H, J= 8.1 Hz), 7.79(d, 2H, J= 8.1 Hz), 7.84 - 7.89(m, 2H), 8.41(br s, 1H). HPLC Rt= 2.646 min. LRMS (m/z) 375(M+H). Anal.(C₂₃H₂₆N₄O) C, H, N.

215: 1 - [4 - (1,3,3 - 6 - - [3.2.1] - 6 -) -] - 8,9 - - 7 H
 H - 2,7,9a - - [cdcd] - 6 -



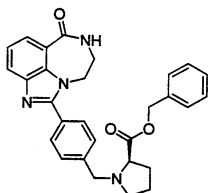
171, 171a, 155.3
 mg(36%)가 : $^1\text{H NMR}$ (DMSO - d_6) 0.88(s, 3H), 1.01(s, 3H), 1.31(t, 2H, J= 10.3 Hz), 1.30 - 1.43(m, 5H), 1.48 - 1.59(m, 1H), 1.61 - 1.72(m, 1H), 2.12(d, 1H, J= 9.4 Hz), 2.91(d, 1H, J= 9.4 Hz), 3.04(m, 1H), 3.48 - 3.57(m, 2H), 3.75(d, 1H, J= 14.2 Hz), 3.89(d, 1H, J= 14.2 Hz), 4.42 - 4.49(m, 2H), 7.34(t, 1H, J= 7.8 Hz), 7.53(d, 2H, J= 8.2 Hz), 7.80(d, 2H, J= 8.2 Hz), 7.84 - 7.90(m, 2H), 8.41(br s, 1H). HPLC Rt= 3.256 min. LRMS(m/z) 429(M+H). Anal.(C₂₇H₃₂N₄O · 0.5CH₃OH) C, H, N.

216: 1 - [4 - ((2S, 5S) - 2,5 - - - 1 -) -] - 8,9 - - 7 HH - 2,7,
 9a - - [cdcd] - 6 -



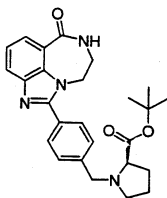
171, 171a, 123mg
 (29%)가 : $^1\text{H NMR}$ (DMSO - d_6) 1.50 - 1.63(m, 2H), 1.82 - 1.95(m, 2H), 3.05 - 3.17(m, 2H), 3.23 - 3.37(m, 10H), 3.49 - 3.57(m, 2H), 3.93(d, 1H, J= 14.9 Hz), 4.05(d, 1H, J= 14.9 Hz), 4.43 - 4.49(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.53(d, 2H, J= 8.1 Hz), 7.79(d, 2H, J= 8.1 Hz), 7.84 - 7.90(m, 2H), 8.41(br s, 1H). HPLC Rt= 2.819 min. LRMS(m/z) 435(M+H). Anal.(C₂₅H₃₀N₄O) C, H, N.

217: (R) - 1 - [4 - (6 - - 6,7,8,9 - - 2,7,9a - - [cdcd] - 1 -) -] - - 2 -



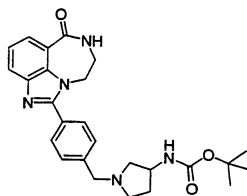
171, 171a, 192.3
 mg(41%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.74 - 1.91(m, 3H), 2.08 - 2.15(m, 1H), 2.42 - 2.53(m, 1H), 2.86 - 2.93(m, 1H), 3.36 - 3.43(m, 1H), 3.47 - 3.55(m, 2H), 3.61(d, 1H, J = 13.5 Hz), 3.98(d, 1H, J = 13.5 Hz), 4.40 - 4.48(m, 2H), 5.11(s, 2H), 7.29 - 7.38(m, 6H), 7.45(d, 2H, J = 8.1 Hz), 7.78(d, 2H, J = 8.1 Hz), 7.85 - 7.91(m, 2H), 8.41(br s, 1H). HPLC Rt = 3.214 min. LRMS(m/z) 481(M+H). Anal. (C₂₉H₂₈N₄O₃) C, H, N.

218: (R) - 1 - [4 - (6 - 6,7,8,9 - 2,7,9a - [cdcd] - 1 -) -] - 2 - tert -



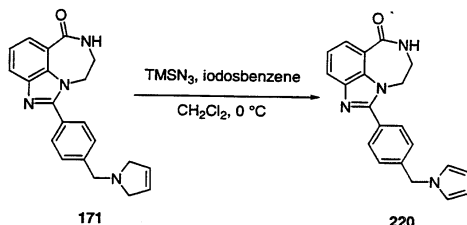
171, 171a, 24.7mg
 (5%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.41(s, 9H), 1.72 - 1.85(m, 3H), 1.99 - 2.10(m, 1H), 2.36 - 2.46(m, 1H), 2.83 - 2.93(m, 1H), 3.16 - 3.26(m, 1H), 3.48 - 3.57(m, 2H), 3.61(d, 1H, J = 13.6 Hz), 3.98(d, 1H, J = 13.6 Hz), 4.42 - 4.50(m, 2H), 7.35(t, 1H, J = 7.8 Hz), 7.50(d, 2H, J = 8.1 Hz), 7.81(d, 2H, J = 8.1 Hz), 7.84 - 7.90(m, 2H), 8.41(br s, 1H). HPLC Rt = 2.958 min. HRMS calcd for C₂₆H₃₁N₄O₃ 447.2391(M+H)⁺, found 447.2377. Anal. (C₂₆H₃₀N₄O₃ · 0.5H₂O, 0.75TFA) C, H, N.

219: { 1 - [4 - (6 - 6,7,8,9 - 2,7,9a - [cdcd] - 1 -) -] - 3 - } - (carbamic acid) tert -



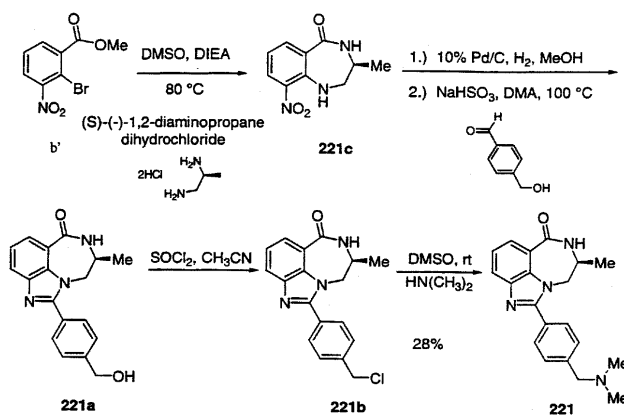
171, 171a, 39.8mg (9%)가 : ¹H NMR(DMSO - d₆) 1.36(s, 9H), 1.54 - 1.66(m, 1H), 1.97 - 2.11(m, 1H), 2.24 - 2.33(m, 1H), 2.52 - 2.59(m, 1H), 2.71 - 2.81(m, 1H), 3.49 - 3.57(m, 2H), 3.65(s, 2H), 3.86 - 3.97(m, 2H), 4.42 - 4.49(m, 2H), 6.93(br s, 1H), 7.35(t, 1H, J= 7.8 Hz), 7.50(d, 2H, J= 8.2 Hz), 7.81(d, 2H, J= 8.2 Hz), 7.84 - 7.91(m, 2H), 8.41(br s, 1H). HPLC Rt= 2.968 min. HRMS calcd for C₂₆H₃₂N₅O₃ 461.2519(M+H)⁺, found 461.2500. Anal.(C₂₆H₃₁N₅O₃ · 0.5) C, H, N.

220: 1 - (4 - - 1 - -) - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



2Ml CH₂Cl₂ 1 - [4 - (2,5 - - 1 -) -] - 8,9 - - 7H - 2,7,9a - [cd] - 6 - (32.4mg, 0.09mmol, 171), (41.4mg, 0.19mmol) (25μl, 0.19mmol) 0 가 . 1 prep HPLC , 20.1mg(55%) : ¹H NMR(DMSO - d₆) 3.46 - 3.54(m, 2H), 4.40 - 4.46(m, 2H), 5.22(s, 2H), 6.05(t, 2H, J= 2.1 Hz), 6.87(t, 2H, J= 2.1 Hz), 7.32 - 7.37(m, 3H), 7.81 - 7.90(m, 4H), 8.41(br s, 1H). HPLC Rt= 3.349 min. HRMS calcd for C₂₁H₁₉N₄O 443.1553(M+H)⁺, found 443.1558. Anal.(C₂₁H₁₈N₄O · TFA) C, H, N.

221: (S) - 1 - (4 - -) - 8 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6 -



(221c)(S) - 3 - - 9 - - 1,2,3,4 - - [e][1,4] - 5 -

130Mℓ DMSO b' 10.1g(38.4mmol, 2),(S) - (-) - 1,2 -
 (5.65g, 38.4mmol) DIEA(22Mℓ, 126mmol) 80 16 가 ,
 , 1.0M NaHSO₄ 200Mℓ 가 . CH₂Cl₂
 (2 x 200Mℓ). (MgSO₄), , .
 2 - 5% MeOH/CH₂Cl₂ , / 3.60g(42
 %) . mp= 215 - 216 C; IR(KBr) 3360, 3179, 3040, 2922, 1654, 1599, 1510, 1451, 1438, 1387, 12
 63, 1193, 1113, 1092, 891 740, 647cm⁻¹; ¹H NMR(CDCl₃) 1.35(d, 3H, J= 6.7 Hz), 3.50 - 3.90(m, 3H),
 6.38(br s, 1H), 6.77(t, 1H, J= 8.1 Hz), 8.34 - 8.46(m, 2H), 9.04(br s, 1H). HPLC Rt= 3.351 min. LRMS(m
 /z) 222(M+H). Anal.(C₁₀ H₁₁ N₃ O₃) C, H, N.

(221a)(S) - 1 - (4 - -) - 8 - - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -

(S) - 3 - - 9 - - 1,2,3,4 - - [e][1,4] - 5 - (2.00g, 9.04mmol)
 MeOH 2 19
 , 221a , 2.30g(82%) . mp= 268 - 270 C; IR(KBr) 3199,
 1654, 1482, 1438, 1389, 1332, 750cm⁻¹; ¹H NMR(CDCl₃) 1.19(d, 3H, J= 6.1 Hz), 3.80 - 3.94(m, 1H), 4.
 28(d, 1H, J= 13.0 Hz), 4.45(dd, 1H, J= 13.0, 7.8 Hz), 4.61(d, 2H, J= 5.4 Hz), 5.33(t, 1H, J= 5.4 Hz), 7.36
 (t, 1H, J= 7.7 Hz), 7.52(d, 2H, J= 7.9 Hz), 7.81(d, 2H, J= 7.9 Hz), 7.85 - 7.93(m, 2H), 8.29(d, 1H, J= 3.3
 Hz). HPLC Rt= 2.543 min. LRMS(m/z) 308(M+H). Anal.(C₁₈ H₁₇ N₃ O₂) C, H, N.

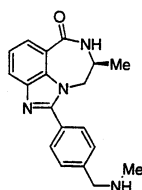
(221b)(S) - 1 - (4 - -) - 8 - - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -

171 , 221a 221b . HPLC
 R_t = 3.233min.

(221)

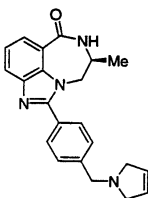
171 , 221b , 61.7mg
 (20%)가 . ¹H NMR(DMSO - d₆) 1.16 - 1.24(m, 3H), 2.22(s, 6H), 3.52(s, 2H), 3.83 - 3.89(m, 1H),
 4.27 - 4.49(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.49(d, 2H, J= 8.1 Hz), 7.81(d, 2H, J= 8.1 Hz), 7.85 - 7.89(m,
 2H), 8.28(br s, 1H). HPLC Rt= 2.471 min. LRMS(m/z) 335(M+H). Anal.(C₂₀ H₂₂ N₄ O • 0.6H₂O) C, H, N.

222: (S) - 8 - - 1 - (-) - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



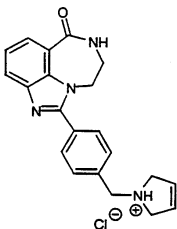
171 , 221b , 87.9mg
 (35%)가 . ¹H NMR(DMSO - d₆) 1.16 - 1.23(m, 3H), 2.60 - 2.65(m, 3H), 3.81 - 3.94(m, 1H), 4.21
 - 4.31(m, 3H), 4.44 - 4.51(m, 2H), 7.38(t, 1H, J= 7.8 Hz), 7.67(d, 2H, J= 8.2 Hz), 7.88 - 7.95(m, 4H), 8.3
 3(br s, 1H). HPLC Rt= 2.315 min. LRMS(m/z) 321(M+H). Anal.(C₁₉ H₂₀ N₄ O • TFA) C, H, N.

223: (S) - 1 - [4 - (2,5 - - - 1 -) -] - 8 - - 8,9 - - 7 HH - 2,7,9a -
 - [cdcd] - 6 -



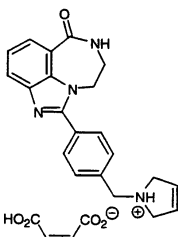
171, 221b, 173mg
 (63%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 1.17 - 1.24(m, 3H), 3.84 - 3.93(m, 1H), 4.01 - 4.19(m, 4H), 4.24 - 4.53(m, 2H), 4.57 - 4.63(m, 2H), 5.97(m, 2H), 7.39(t, 1H, J= 7.8 Hz), 7.76(d, 2H, J= 8.3 Hz), 7.89 - 7.93(m, 2H), 7.95(d, 2H, J= 8.3 Hz), 8.34(br s, 1H). HPLC Rt= 2.554 min. LRMS(m/z) 359(M+H). Anal. (C₂₂H₂₂N₄O · 0.5 H₂O, 2 TFA) C, H, N.

224: 1 - [4 - (2,5 - - 1 -) -] - 8,9 - - HH - 2,7,9a - - [c dcd] - 6 - ,



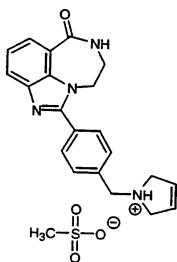
5Ml 1 - [4 - (2,5 - - 1 -) -] - 8,9 - - 7H - 2,7,9a - - [c d] - 6 - (171)(40mg, 0.12mmol) , 0.10N HCl(1.13Ml, 0.12mmol) 가 . , . 39.4mg(84%) . $^1\text{H NMR}(\text{DMSO}-d_6)$ 3.50 - 3.59(m, 2H), 3.88 - 4.12(m, 4H), 4.42 - 4.57(m, 4H), 5.93(s, 2H), 7.37(t, 1H, J= 7.7 Hz), 7.75 - 7.84(m, 2H), 7.86 - 7.98(m, 4H), 8.45(br s, 1H), 11.41 br s, 1H). HPLC Rt= 2.527 min. LRMS(m/z) 345(M+H). Anal. (C₂₁H₂₀N₄O · 1.0 HCl, 1.25 H₂O) C, H, N.

225: 1 - [4 - (2,5 - - 1 -) -] - 8,9 - - HH - 2,7,9a - - [c dcd] - 6 - ,



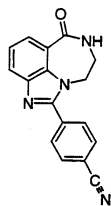
224, 1-[4-(2,5-dimethyl-1H-imidazol-1-yl)-8,9-dihydro-7H-pyrido[2,7,9a-g]indol-6-yl]maleic acid (maleic acid). 42.3mg (75%). ¹H NMR(DMSO-d₆) 3.51-3.59(m, 2H), 3.90-4.07(m, 4H), 4.43-4.55(m, 4H), 5.94(s, 2H), 6.02(s, 2H), 7.37(t, 1H, J= 7.8 Hz), 7.68-7.75(m, 2H), 7.86-7.98(m, 4H), 8.45(br s, 1H), 10.65(br s, 2H). HPLC Rt= 2.521 min. LRMS(m/z) 345(M+H). Anal.(C₂₁H₂₀N₄O • 1.0 C₄H₄O₄, 1.5 H₂O) C, H, N.

226: 1-[4-(2,5-dimethyl-1H-imidazol-1-yl)-8,9-dihydro-7H-pyrido[2,7,9a-g]indol-6-yl]maleic acid [c dcd]



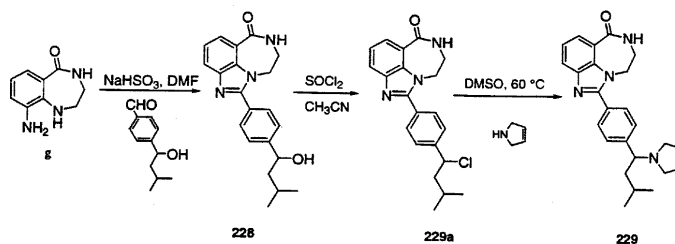
224, 1-[4-(2,5-dimethyl-1H-imidazol-1-yl)-8,9-dihydro-7H-pyrido[2,7,9a-g]indol-6-yl]maleic acid. 42.3mg (75%). ¹H NMR(DMSO-d₆) 2.29(s, 3H), 3.52-3.58(m, 2H), 3.90-4.14(m, 4H), 4.43-4.60(m, 4H), 5.96(s, 2H), 7.38(t, 1H, J= 7.8 Hz), 7.74(d, 2H, J= 8.2 Hz), 7.86-7.92(m, 2H), 7.96(d, 2H, J= 8.2 Hz), 8.45(br s, 1H), 10.52(br s, 1H). HPLC Rt= 2.525 min. LRMS(m/z) 345(M+H). Anal.(C₂₁H₂₀N₄O • 1.0 C₄H₄O₃S • 1.25H₂O) C, H, N.

227: 4-(6-(2,5-dimethyl-1H-imidazol-1-yl)-8,9-dihydro-7H-pyrido[2,7,9a-g]indol-1-yl)maleic acid [c dcd]



219, 1-[4-(2,5-dimethyl-1H-imidazol-1-yl)-8,9-dihydro-7H-pyrido[2,7,9a-g]indol-6-yl]maleic acid. 316.7mg (57%). ¹H NMR(DMSO-d₆) 3.49-3.58(m, 2H), 4.44-4.52(m, 2H), 7.39(t, 1H, J= 7.9 Hz), 7.89-7.96(m, 2H), 8.06(m, 4H), 8.45(br s, 1H). HPLC Rt= 2.842 min. LRMS(m/z) 289(M+H). Anal.(C₁₇H₁₂N₄O • 0.25H₂O) C, H, N.

228-229: 1-[4-(1-(2,5-dimethyl-1H-imidazol-1-yl)-3-oxo-1,2,3,4-tetrahydro-7H-pyrido[2,7,9a-g]indol-7-yl)maleic acid [c dcd]



(228) 1 - [4 - (1 - 3 -) -] - 8,9 - 7H - 2,7,9a - [cd] - 6 -

19, 8.36g(91%) ¹H NMR(DMSO - d₆) 0.89 - 0.95(s, 6H), 1.34 - 1.44(m, 1H), 1.53 - 1.64(m, 1H), 1.66 - 1.79(m, 1H), 3.48 - 3.57(m, 2H), 4.42 - 4.49(m, 2H), 4.64 - 4.70(m, 1H), 5.21(d, 1H, J= 4.9 Hz), 7.35(t, 1H, J= 7.8 Hz), 7.51(d, 2H, J= 8.2 Hz), 7.81(d, 2H, J= 8.2 Hz), 7.84 - 7.90(m, 2H), 8.41(br s, 1H), 10.52(br s, 1H). HPLC Rt= 3.171 min. LRMS(m/z) 350(M+H). Anal.(C₂₁ H₂₃ N₃ O₂) C, H, N.

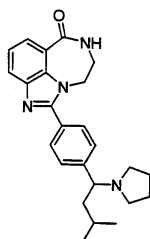
(229a) 1 - [4 - (1 - 3 -) -] - 8,9 - 7H - 2,7,9a - [cd] - 6 -

171, 228, 8.36g(91%) LRMS(m/z) 368(M+H).

(229)

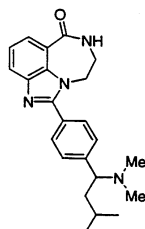
60 가 171, 229a 6, 83.3mg(30%) ¹H NMR(DMSO - d₆) 0.90(d, 3H, J= 6.6 Hz), 0.91(d, 3H, J= 6.6 Hz), 1.11 - 1.25(m, 1H), 1.59 - 1.76(m, 2H), 3.35 - 3.68(m, 7H), 4.42 - 4.52(m, 2H), 5.77(s, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.50(d, 2H, J= 8.1 Hz), 7.79 - 7.89(m, 4H), 8.42(br s, 1H). HPLC Rt= 3.034 min. LRMS(m/z) 401(M+H). Anal.(C₂₅ H₂₈ N₄ O · 0.3H₂O) C, H, N.

230: 1 - [4 - (3 - 1 - 1 -) -] - 8,9 - 7 HH - 2,7,9a - [cdcd] - 6 -



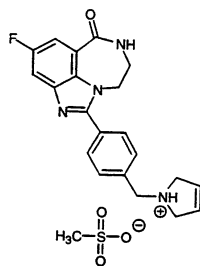
229, 229a, 118mg
 (43%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 0.80(d, 3H, J= 6.6 Hz), 0.88(d, 3H, J= 6.6 Hz), 1.10 - 1.25(m, 1 H), 1.57 - 1.79(m, 6H), 2.21 - 2.33(m, 2H), 2.52 - 2.57(m, 2H), 3.32 - 3.38(m, 1H), 3.49 - 3.58(m, 2H), 4.43 - 4.51(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.47(d, 2H, J= 8.2 Hz), 7.82(d, 2H, J= 8.2 Hz), 7.85 - 7.89(m, 2 H), 8.42(br s, 1H). HPLC Rt= 3.029 min. LRMS(m/z) 403(M+H). Anal. (C₂₅H₃₀N₄O · 0.25 H₂O) C, H, N.

231: 1 - [4 - (- -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



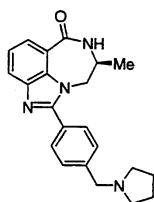
229, 229a, 85.1mg
 (33%)가 : $^1\text{H NMR}(\text{DMSO}-d_6)$ 0.85(d, 3H, J= 6.6 Hz), 0.88(d, 3H, J= 6.6 Hz), 1.28 - 1.39(m, 1 H), 1.56 - 1.67(m, 1H), 1.69 - 7.80(m, 1H), 2.09(s, 6H), 3.40 - 3.49(m, 1H), 3.50 - 3.58(m, 2H), 4.44 - 4.51(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.43(d, 2H, J= 8.2 Hz), 7.83(d, 2H, J= 8.2 Hz), 7.84 - 7.90(m, 2H), 8.42(br s, 1H). HPLC Rt= 2.869 min. LRMS(m/z) 377(M+H). Anal. (C₂₃H₂₈N₄O · 0.25H₂O) C, H, N.

232: 1 - [4 - (2,5 - - 1 -) -] - 4 - - 8,9 - - 7 HH - 2,7,9a -
 - [cdcd] - 6 - ,



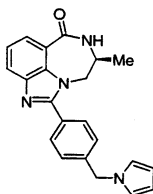
224, 1 - [4 - (2,5 - - 1 -) -] - 4 -
 - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - [177]
 . 577.9mg(90%) . $^1\text{H NMR}(\text{DMSO}-d_6)$ 2.31(s, 3H), 3.54 - 3.60(m, 2H), 4.03 - 4.15(m, 4H), 4.44 - 4.50(m, 4H), 5.98(s, 2H), 7.64(dd, 1H, J= 10.6, 2.6 Hz), 7.75 - 7.81(m, 3H), 7.98(d, 2H, J= 8.3 Hz), 8.63(br s, 1H), 10.57(br s, 1H). HPLC Rt= 2.813 min. LRMS(m/z) 363(M+H). Anal. (C₂₁H₁₉FN₄O · 1.0 CH₄O₃S, 0.25H₂O) C, H, N.

233: (S) - 8 - - 1 - (4 - - 1 - -) - 8,9 - - 7 HH - 2,7,9a - - [c
 dcd] - 6 -



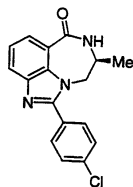
221b, 50mg (11%) : ¹H NMR(DMSO - d₆) 1.20(d, 3H, J= 6.3 Hz), 1.68 - 1.87(m, 4H), 2.43 - 2.57(m, 4H), 3.69(s, 2H), 3.81 - 3.93(m, 1H), 4.30(d, 1H, J= 13.2 Hz), 4.46(dd, 1H, J= 13.2, 7.8 Hz), 7.35(t, 1H, J= 7.8 Hz), 7.51(d, 2H, J= 8.2 Hz), 7.81(d, 2H, J= 8.2 Hz), 7.85 - 7.95(m, 2H), 8.29(d, 1H, J= 4.2 Hz). LRMS(m/z) 361(M+H). Anal.(C₂₂H₂₄N₄O • H₂O) C, H, N.

234: (S) - 8 - 1 - (4 - 1 -) - 8,9 - 7 HH - 2,7,9a - [cdcd] - 6 -



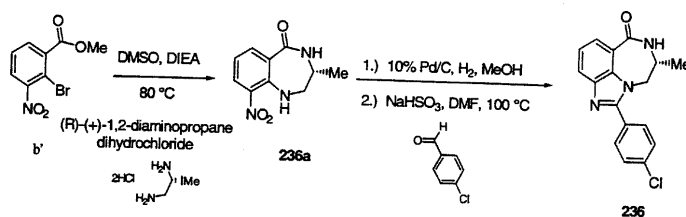
223, 50mg (3%) : ¹H NMR(DMSO - d₆) 1.18(d, 3H, J= 6.3 Hz), 3.78 - 3.90(m, 1H), 4.27(d, 2H, J= 13.2 Hz), 4.44(dd, 1H, J= 13.2, 7.8 Hz), 5.22(s, 2H), 6.06(t, 1H, J= 2.1 Hz), 6.88(t, 1H, J= 2.1 Hz), 7.30 - 7.39(m, 3H), 7.79 - 7.92(m, 4H), 8.29(d, 1H, J= 4.31 Hz). HRMS calcd for C₂₂H₂₁N₄O 357.1710(M+H)⁺, found 357.1711.

235: (S) - 1 - (4 -) - 8 - 8,9 - 7 HH - 2,7,9a - [cdcd] - 6 -



221, (S) - 3 - 9 - 1,2,3,4 - [e][1,4] - 5 - 4 - 35mg (7%) : mp= 244 - 246 °C; ¹H NMR(DMSO - d₆) 1.20(d, 3H, J= 4.8 Hz), 3.77 - 3.93(m, 1H), 4.29(d, 1H, J= 12.6 Hz), 4.45(dd, 1H, J= 13.0, 7.9 Hz), 7.37(t, 1H, J= 7.8 Hz), 7.66(d, 2H, J= 8.4 Hz), 7.82 - 7.96(m, 4H), 8.33(br s, 1H). HPLC Rt= 3.217 min. LRMS(m/z) 312(M+H). Anal.(C₁₇H₁₄ClN₃O) C, H, Cl, N.

236: (R) - 1 - (4 -) - 8 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd] - 6



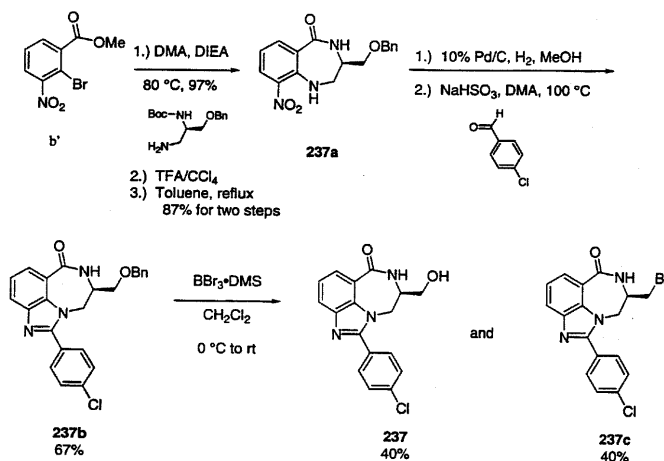
(236a) (R) - 3 - - 9 - - 1,2,3,4 - - [e][1,4] - 5 -

, 221 221c (enantiomer),
 . 2.14g (29%) . HPLC R_t = 3.379min.

(236)

235 235, (R) - 3 - - 9 - - 1,
 2,3,4 - - [e][1,4] - 5 - 4 - . 210mg (37%)
 . LRMS(m/z) 312(M+H). Anal.(C₁₇H₁₄ClN₃O · 0.10CH₂Cl₂, 0.05) C, H, Cl, N.

237: (R) - 1 - (4 -) - 8 - - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
 - 6 -



(237a) (R) - 3 - - 9 - - 1,2,3,4 - - [e][1,4] - 5 -

50Mℓ DMA tert - b' 2.23g(8.57mmol, 2), ((R) - 2 - - 1 - -) -
 (2.40g, 8.56mmol) DIEA(2.5Mℓ, 14.4mmol) 80 가 .
 1.0M NaH₂PO₄ 500Mℓ 가 , 1:1 Et₂O/ (3 x 250Mℓ)
 (MgSO₄), , , , 5% t - BuOMe/(1:1 CH₂Cl₂/)
 , (R) - 3 - - 2 - tert -
 -) - 3 - - 3.81g(97%) []. IR(KBr) 3314, 29
 77, 1715, 1694, 1606, 1531, 1505, 1366, 1348, 1260, 1165, 1120, 741cm⁻¹; ¹H NMR(CDCl₃) 1.41(s, 9
 H), 3.08 - 3.21(m, 2H), 3.47 - 3.58(m, 2H), 3.87(s, 3H), 3.98(br s, 1H), 4.43 - 4.54(m, 2H), 4.92(br d, 1
 H, J= 8.6 Hz), 6.69(t, 1H, J= 7.9 Hz), 7.24 - 7.36(m, 5H), 7.96 - 8.05(m, 2H), 8.57(br s, 1H). HPLC Rt= 5.
 030 min. HRMS calcd for C₂₃H₂₉N₃NaO₇ 482.1903(M+Na)⁺, found 482.1901. Anal.(C₁₀H₁₁N₃O₃) C, H,
 N.

75Mℓ 1:1 TFA/CCl₄ 2 , Boc
 , pH 7 250Mℓ , CHCl₃ (4 x 100Mℓ).
 (MgSO₄), , , 3.25g
 [HRMS calcd C₁₈H₂₂N₃O₅ 360.1559(M+H)⁺, found 360.1557]. , 150Mℓ
 , 237a 2.33g . ¹H NMR(DMS
 O - d₆) 3.48(d, 2H, J= 6.2 Hz), 3.60 - 3.75(m, 3H), 4.46 - 4.56(m, 2H), 6.76(t, 1H, J= 8.0 Hz), 7.20 - 7.
 36(m, 5H), 8.21 - 8.34(m, 3H), 8.79(br s, 1H). HPLC Rt= 4.441 min. LRMS(m/z) 328(M+H). Anal.(C₁₇H
 17N₃O₄ · 0.60 H₂O) C, H, N.

(237b) (R) - 8 - - 1 - (4 - -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -
 - AG - 14523

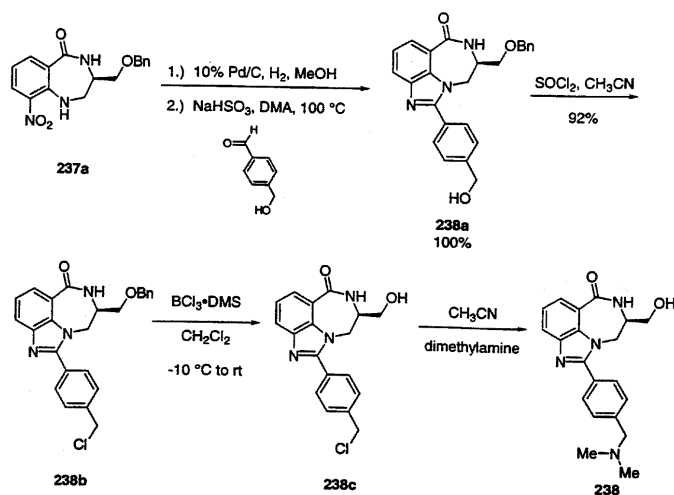
221 , (R) - 3 - - 9 -
 - 1,2,3,4 - - [e][1,4] - 5 - 4 - . ¹H NMR(C
 DCl₃) 3.62(d, 2H, J= 5.6 Hz), 3.96 - 4.05(m, 1H), 4.38(d, 1H, J= 12.5 Hz), 4.46 - 4.60(m, 3H), 6.61(d,
 1H, J= 4.3 Hz), 7.18 - 7.39(m, 5), 7.42(t, 1H, J= 7.9 Hz), 7.49(d, 2H, J= 8.5 Hz), 7.70(d, 2H, J= 8.5 Hz),
 7.99(dd, 1H, J= 8.0, 0.8 Hz), 8.13(dd, 1H, J= 7.7, 0.8 Hz). HPLC Rt= 4.228 min. HRMS calcd for C₂₄H₂₁
 ClN₃O₂ 418.1322(M+H)⁺, found 418.1334. Anal.(C₂₄H₂₀ClN₃O₂) C, H, Cl, N.

(237)

7.5Mℓ CH₂Cl₂ 237b(0.21g, 0.50mmol) , (C
 H₂Cl₂ 1.0M , 2.5Mℓ, 2.5mmol) 0 가 . 가
 , 1.0M LiOH 10Mℓ, EtOH 15Mℓ MeOH 2Mℓ
 가 가 . 3 , 1.0M KH₂PO₄ 75Mℓ , EtOAc (3 x 50Mℓ).
 (MgSO₄), , , 2.5 - 5% MeOH/CH₂Cl₂
 , 70mg(40%) . ¹H NMR(DMSO - d₆) 3.
 30 - 3.78(m, 3H), 4.40 - 4.57(m, 2H), 5.02(br s, 1H), 7.38(t, 1H, J= 7.8 Hz), 1.67(d, 2H, J= 8.3 Hz), 7.85
 - 7.97(m, 4H), 8.16(br d, 1H, J= 3.9 Hz). HPLC Rt= 2.822 min. HRMS calcd for C₁₇H₁₅ClN₃O₂ 328.0853
 (M+H)⁺, found 328.0825. Anal.(C₁₇H₁₄ClN₃O₂ · 0.15 CH₂Cl₂) C, H, Cl, N.

(237c) (R) - 8 - - 1 - (4 - -) - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -
 , 237 80mg(40%)
 . ¹H NMR(CDCl₃) 3.38 - 3.57(m, 2H), 4.06 - 4.17(m, 1H), 4.50(dd, 1H, J= 13.3, 1.2 Hz), 4.74(dd, 1H,
 J= 13.3, 6.7 Hz), 6.65(br s, 1H), 7.45(t, 1H, J= 7.9 Hz), 7.52 - 7.74(m, 4H), 8.02(dd, 1H, J= 8.0, 1.1 Hz),
 8.15(dd, 1H, J= 7.7, 1.1 Hz). HPLC Rt= 3.506 min. LRMS(m/z) 390(M+H).

238: (R) - 1 - (4 - -) - 8 - - 8,9 - - 7 HH - 2,7,9a - -
 [cdcd] - 6 -



(238a) (R) - 8 - 1 - (4 -) - 8,9 - 7H - 2,7,9a - [cd]
- 6 -

237, (R) - 3 - 9 -
- 1,2,3,4 - [e][1,4] - 5 - 4 - IR
(KBr) 3293, 2925, 1654, 1602, 1482, 1115, 750 cm^{-1} ; $^1\text{H NMR}(\text{CDCl}_3)$ 2.09(br s, 1H), 3.56 - 3.66(m, 2 H), 3.95 - 4.04(m, 1H), 4.37 - 4.60(m, 4H), 4.82(s, 2H), 6.51(d, 1H, J= 4.4 Hz), 7.20 - 7.38(m, 5H), 7.42 (t, 1H, J= 7.9 Hz), 7.51(d, 2H, J= 8.2 Hz), 7.73(d, 2H, J= 8.2 Hz), 8.00(dd, 1H, J= 8.0, 1.0 Hz), 8.12(dd, 1H, J= 7.7, 1.0 Hz). HPLC Rt= 3.330 min. HRMS calcd for $\text{C}_{25}\text{H}_{24}\text{N}_3\text{O}_3$ 414.1818(M+H) $^+$, found 414.182 2.

(238b) (R) - 8 - 1 - (4 -) - 8,9 - 7H - 2,7,9a - [cd]
- 6 -

171, 238a, $^1\text{H NMR}(\text{CDCl}_3)$ 3.60 - 3.68(m, 2H), 3.97 - 4.06(m, 1H), 4.38 - 4.60(m, 2H), 4.52(s, 2H), 4.67(s, 2H), 6.52(d, 1 H, J= 4.4 Hz), 7.20 - 7.40(m, 5H), 7.42(t, 1H, J= 7.9 Hz), 7.55(d, 2H, J= 8.2 Hz), 7.76(d, 2H, J= 8.2 Hz), 8.00(dd, 1H, J= 8.0, 1.0 Hz), 8.13(dd, 1H, J= 7.7, 1.0 Hz). HPLC Rt= 3.953 min. HRMS calcd for $\text{C}_{25}\text{H}_{22}\text{ClN}_3\text{O}_2$ 432.1473(M+H) $^+$, found 432.1457. Anal. (C₂₅H₂₂ClN₃O₂ · 0.50 H₂O) C, H, N.

(238c) (R) - 1 - (4 -) - 8 - 8,9 - 7H - 2,7,9a - [cd]
- 6 -

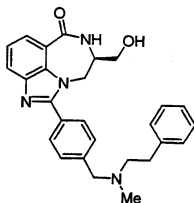
75Mℓ CH_2Cl_2 (2.75g, 15.3mmol) pH 7, 238b(1.35g, 3.12mmol) 0 가 , 가 ,
EtOAc 400Mℓ Et₂O 200Mℓ (MgSO₄), 680mg(64%) 가 가 , 가 ,
HPLC R_t = 2.904min. LRMS(m/z) 342(M+H).

(238)

171

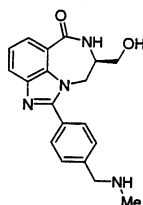
238c . 85.1mg (33%) . ¹H NMR(CDCl₃) 2.30(s, 6H), 3.52(s, 2H), 3.86 - 3.95(m, 2H), 3.97 - 4.08(m, 1H), 4.48 - 4.62(m, 2H), 7.41(t, 1H, J= 7.9 Hz), 7.50(d, 2H, J= 8.2 Hz), 7.73(d, 2H, J= 8.2 Hz), 8.01(dd, 1H, J= 8.0, 1.0 Hz), 8.07(dd, 1H, J= 7.7, 1.0 Hz), 8.60(br s, 1H). HPLC Rt= 2.254 min. HRMS calcd for C₂₀H₂₃N₄O₂ 351.1821(M+H)⁺, found 351.1821.

239: (R) - 8 - 1 - { 4 - [(- -) -] - } - 8,9 - 7 HH - 2,7,9
a - [cdcd] - 6 -



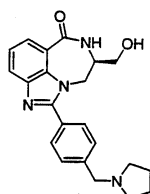
238 . 15.0mg (15%) . ¹H NMR(CDCl₃) 2.33(s, 3H), 2.66 - 2.90(m, 4H), 3.60(br s, 1H), 3.64(s, 2H), 3.84 - 4.07(m, 3H), 4.49 - 4.61(m, 2H), 7.16 - 7.33(m, 5H), 7.42(t, 1H, J= 7.9 Hz), 7.46(d, 2H, J= 8.2 Hz), 7.70(d, 2H, J= 8.2 Hz), 8.01(dd, 1H, J= 8.0, 1.0 Hz), 8.08(dd, 1H, J= 7.7, 1.0 Hz), 8.52(br s, 1H). HPLC Rt= 2.917 min. HRMS calcd for C₂₇H₂₉N₄O₂ 441.2285(M+H)⁺, found 441.2286.

240: (R) - 8 - 1 - (4 - -) - 8,9 - 7 HH - 2,7,9a -
[cdcd] - 6 -



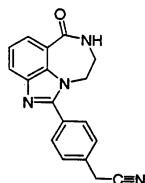
238 . 31.5mg (32%) . ¹H NMR(DMSO - d₆) 2.33(s, 3H), 3.32 - 3.77(m, 3H), 3.77(s, 2H), 4.45 - 4.56(m, 2H), 5.05(br s, 1H), 7.36(t, 1H, J= 7.8 Hz), 7.53(d, 2H, J= 8.0 Hz), 7.82(d, 2H, J= 8.0 Hz), 7.86 - 7.95(m, 2H), 8.16(d, 1H, J= 3.5 Hz). HPLC Rt= 2.119 min. LRMS(m/z) 328(M+H). Anal. (C₁₉H₂₀N₄O₂ · 0.30 CH₂Cl₂) C, H, N.

241: (R) - 8 - 1 - (4 - - 1 - -) - 8,9 - 7 HH - 2,7,9a -
[cdcd] - 6 -



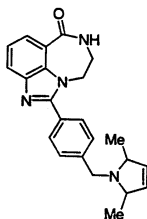
238, 238c . 78mg(72%)
¹H NMR(DMSO - d₆) 1.73(s, 4H), 2.50(s, 4H), 3.30 - 3.78(m, 5H), 4.42 - 4.58(m, 2H), 5.04(br s, 1H), 7.36(t, 1H, J= 7.8 Hz), 7.51(d, 2H, J= 7.8 Hz), 7.81(d, 2H, J= 7.8 Hz), 7.89(d, 2H, J= 7.8 Hz), 8.15(br s, 1H). HPLC Rt= 2.375 min. LRMS(m/z) 377(M+H). Anal.(C₂₂H₂₄N₄O₂ · 0.20 H₂O) C, H, N.

242: [4 - (6 - -6,7,8,9 - -2,7,9a - - [cdcd] - 1 -) -] -



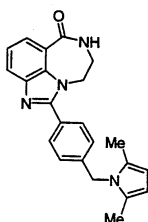
171, 171a, KCN KI . 78mg(72%)
 IR(KBr) 3197, 3071, 2932, 2253, 1661, 1600, 1485, 1460, 1390, 1310, 1218, 1088, 824, 760 cm⁻¹; ¹H NMR(DMSO - d₆) 3.48 - 3.58(m, 2H), 4.18(s, 2H), 4.43 - 4.52(m, 2H), 7.37(t, 1H, J= 7.8 Hz), 7.57(d, 2H, J= 8.2 Hz), 7.86 - 7.95(m, 4H), 8.43(t, 1H, J= 5.6 Hz). HPLC Rt= 2.689 min. HRMS calcd for C₁₈H₁₅N₄O 303.1240(M+H)⁺, found 303.1248. Anal.(C₁₈H₁₄N₄O · 0.50 H₂O) C, H, N.

243: 1 - [4 - (2,5 - -2,5 - - 1 -) -] - 8,9 - - 7 HH - 2,7,9a -
 - [cdcd] - 6 -



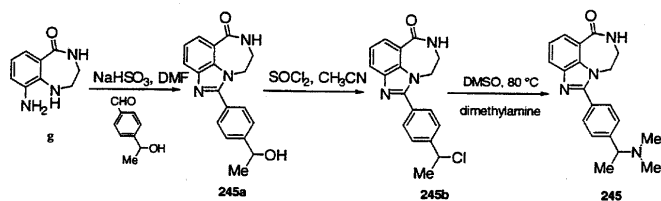
171, 171a . 80mg(17%)
¹H NMR(DMSO - d₆, racemic mixture of cis and trans isomers) 1.01(d, 6H, J= 6.2 Hz), 3.50 - 4.03(m, 4H), 3.92(s, 2H), 5.62 - 5.77(m, 2H), 7.36(t, 1H, J= 7.8 Hz), 7.50 - 7.60(m, 2H), 7.77 - 7.93(m, 4H), 8.42(t, 1H, J= 5.7 Hz). HPLC Rt= 2.611 min. LRMS(m/z) 373(M+H). Anal.(C₂₃H₂₄N₄O · 0.10 H₂O) C, H, N.

244: 1 - [4 - (2,5 - - 1 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
] - 6 -



243 . 15mg(3%) . ¹H NMR(DMSO - d₆) 2.11(s, 6H), 3.47 - 3.58(m, 2H), 4.39 - 4.48(m, 2H), 5.16(s, 2H), 5.75(s, 2H), 7.06(d, 2H, J= 8.2 Hz), 7.35(t, 1H, J= 7.8 Hz), 7.78 - 7.93(m, 4H), 8.41(t, 1H, J= 5.7 Hz). HPLC Rt= 3.613 min. HRMS calcd for C₂₃ H₂₃ N₄ O 371.1866(M+H)⁺, found 371.1863.

245: 1 - [4 - (1 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
- 6 -



(245a) 1 - [4 - (1 -) -] - 8,9 - - 7H - 2,7,9a - - [cd] - 6 - AG - 14659

19 g(2) 4 - (1 -) - [Hulin et al., J. Med. Chem. 35, 1853(1992)]
1.60g(42%) . ¹H NMR(DMSO - d₆) 1.86(d, 3H, J= 6.7 Hz), 3.48 - 3.60(m, 2H), 4.43 - 4.52(m, 2H), 4.78 - 4.89(m, 1H), 5.30(d, 1H, J= 4.3 Hz), 7.36(t, 1H, J= 7.8 Hz), 7.55(d, 2H, J= 8.2 Hz), 7.82(d, 2H, J= 8.2 Hz), 7.85 - 7.93(m, 2H), 8.43(t, 1H, J= 5.7 Hz). LRMS(m/z) 308(M+H). Anal.(C₁₈ H₁₇ N₃ O₂) C, H, N.

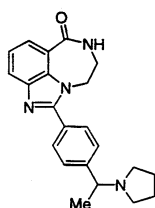
(245b) 1 - [4 - (1 -) -] - 8,9 - - 7H - 2,7,9a - - [cd] - 6 -

171 245a . 0.85g (70%) . ¹H NMR(DMSO - d₆) 1.38(d, 3H, J= 6.5 Hz), 3.48 - 3.60(m, 2H), 4.42 - 4.525(m, 2H), 5.47(q, 1H, J= 6.7 Hz), 7.40(t, 1H, J= 7.8 Hz), 7.71(d, 2H, J= 8.2 Hz), 7.85 - 7.97(m, 4H), 8.46(t, 1H, J= 5.7 Hz). HPLC Rt= 3.280 min. Anal.(C₁₈ H₁₆ ClN₃ O) C, H, Cl, N.

(245)

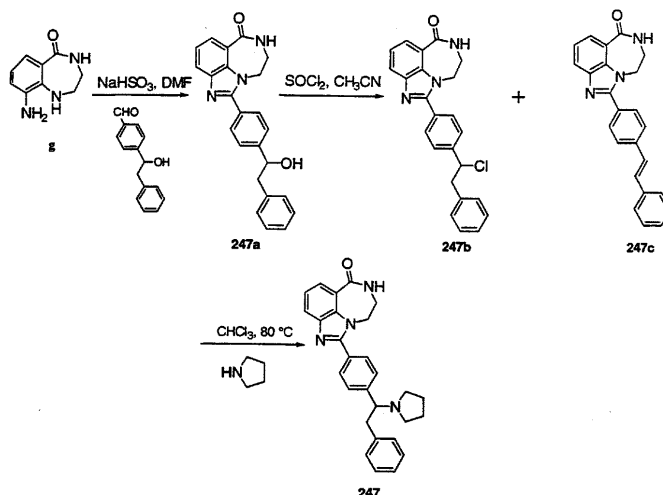
80 가 171 245b . 69mg(42%) . ¹H NMR(DMSO - d₆) 1.32(d, 3H, J= 6.7 Hz), 2.15(s, 6H), 3.34 - 3.44(m, 1H), 3.47 - 3.60(m, 2H), 4.43 - 4.52(m, 2H), 7.36(t, 1H, J= 7.8 Hz), 7.50(d, 2H, J= 8.2 Hz), 7.82(d, 2H, J= 8.2 Hz), 7.85 - 7.93(m, 2H), 8.42(t, 1H, J= 5.7 Hz). HPLC Rt= 2.461 min. LRMS(m/z) 335 (M+H). Anal.(C₂₀ H₂₂ N₄ O) C, H, N.

246: 1 - [4 - (1 -) -] - 8,9 - - 7 HH - 2,7,9a - - [cdcd]
- 6 -



245
 (66%) $^1\text{H NMR}$ (DMSO - d_6) 1.35(d, 3H, J= 6.5 Hz), 1.63 - 1.75(m, 4H), 2.28 - 2.55(m, 4H), 3.23 - 3.38(m, 3H), 3.47 - 3.60(m, 2H), 4.43 - 4.52(m, 2H), 7.35(t, 1H, J= 7.8 Hz), 7.51(d, 2H, J= 8.2 Hz), 7.81(d, 2H, J= 8.2 Hz), 7.85 - 7.93(m, 2H), 8.42(t, 1H, J= 5.7 Hz). HPLC Rt= 2.683 min. LRMS(m/z) 361(M + H). Anal.(C₂₂ H₂₄ N₄ O) C, H, N.

247: 1 - [4 - (2 - 1 - 1 -) -] - 8,9 - 7 HH - 2,7,9a - [cdc] - 6 -



(247a) 1 - [4 - (1 - 2 -) -] - 8,9 - 7H - 2,7,9a - [cd] - 6 -

19 g(2) 4 - (1 - 2 -) - [Hulin et al., J. Med. Chem. 35, 1853(1992)] 9.30g(96%)
 $^1\text{H NMR}$ (DMSO - d_6) 2.95(d, 2H, J= 6.5 Hz), 3.50 - 3.60(m, 2H), 4.40 - 4.52(m, 2H), 4.88(t, 1H, J= 6.5 Hz), 5.43(br s, 1H), 7.13 - 7.30(m, 5H), 7.38(t, 1H, J= 7.8 Hz), 7.52(d, 2H, J= 8.2 Hz), 7.80(d, 2H, J= 8.2 Hz), 7.86 - 7.94(m, 2H), 8.45(t, 1H, J= 5.7 Hz). HPLC Rt= 3.263 min. LRMS(m/z) 384(M + H). Anal.(C₂₄ H₂₁ N₃ O₂ · 0.50 H₂O) C, H, N.

(247b) 1 - [4 - (1 - 2 -) -] - 8,9 - 7H - 2,7,9a - [cd] - 6 -

171 g(75%) 247a 3.53
 HPLC R_t = 3.871min. LRMS(m/z) 402(M + H).

(247c) 1 - [4 - ((E) -) -] - 8,9 - 7H - 2,7,9a - [cd] - 6 - AG - 144
 60

247b $^1\text{H NMR}$ (DMSO - d_6) 3.50 - 3.60(m, 2H), 4.46 - 4.57(m, 2H), 7.28 - 7.47(m, 6H), 7.63 - 7.95(m, 8H), 8.45(t, 1H, J= 5.7 Hz). HPLC Rt= 3.929 min. LRMS(m/z) 366(M + H). Anal.(C₂₄ H₁₉ N₃ O · 0.10 H₂O) C, H, N.

(247)

b . 40mg(11%) . ¹H NMR(DMSO - d₆) 1.63 - 1.76(m, 4H), 2.34 - 2.68(m, 4H), 2.92(dd, 1H,J= 12.9, 10.0 Hz), 3.30 - 3.40(m, 1H), 3.48 - 3.62(m, 3H), 4.35 - 4.46(m, 2H), 6.93 - 7.39(m, 8H), 7.66 - 7.90(m, 4H), 8.41(t, 21H,J= 5.7 Hz). HPLC Rt= 3.120 min. LRMS(m/z) 437(M+H). Anal.(C₂₈ H₂₈ N₄O) C, H, N.

PARP :

PARP - Simmon et al.(J. Biol. Chem.(1993), 268: 8529 - 8535) Marsischky et al.(J. Biol. Chem.(1995), 270: 3247 - 3254) . 20nM
 PARP , 10µg/ml DNase I - DNA(sigma), 500 µ M NAD⁺ , 0.5 µ Ci[³² P]NAD⁺ , 2% DMSO (50µl) (50mM (Tris) pH 8.0, 10mM MgCl₂, 1mM () . HCl) , 25 5 , 40%
 가 , 15 Bio - Dot (microfiltration apparatus)(BioRad) , Whatman GF/C - (glass - fiber) , 150µl (5% , 1%) 3 [³² P]
 ADP - , PhosphorImager(Molecular Dynamics) ImageQuant software (Ki) , (Segel,Enzyme Kinetics: Behavior and Analysis of Rapid Equilibrium and Steady - State Enzyme Systems, John Wiley & Sons, Inc., New York(1975), 100 - 125) (tight - binding inhibitors) , 5nM 가
 , 25 25 Ki Sculley et al.(Biochem. Biophys. Acta(1986), 874: 44 - 53)

가 :

, A549 (ATCC, Rockville, MD) 96 - 16 24
 () 0.4 µ M
 3 5 가 , MTT SRB . MTT
 , 0.2µg/µl MTT(3 - (4,5 - - 2 -) - 2,5 -)(Sigma Chemical Co., St. Louis, MO) 가 , 4
 MTT 150µl DMSO(Sigma Chemical Co.) , Wallac 1420 Victor (EG& G Wallac, Gaithersburg, MD) 540nm . SRB , 10%
 (Sigma Chemical Co) 4 1 , 1% (S
 igma Chemical Co) 0.4% B(Sulforhodamine B)(SRB, Sigma Chemical Co.) 30
 SRB 1% ,
 10mM (Sigma Chemical Co) . Walla
 c Victor 515nm (mock) - OD
 - OD() ,
 50% IC₅₀ (topotecan) 가
 (temozolomide) (cytotoxicity potentiation) , 가
 PF₅₀ , IC₅₀ PF₅₀ IC₅₀
 IC₅₀ (Ki) (PF₅₀) , 1

[1]

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K_i (nM)	Cytotoxicity Potentiation PF ₅₀
1	4.1, 6.2	1.5
2	8.0, 6.0	1.6
3	10.9, 12	1.4
4	6.5	1.5
5	7.7	1.3
6	4.3	2
7	5.1	1.4
8	6.2	1.9
9	49	1.4
10	11.2	1.7
11	5.6	2.1

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K_i (nM)	Cytotoxicity Potentiation PF ₅₀
12	21, 17	1.3
13	10.1	ND
14	5.7, 7.6	1.8
15	12.1	ND
16	7.2	ND
17	4.8, 5.3	1.7
18	3.4	2
19	13	ND
20	11.9	ND
21	13.7, 13.0	ND
22	13, 14, 15	ND
23	17.3	ND
24	29	ND
25	176	1.4
26	102	1.1
27	>5000	ND
28	10	ND
29	24	ND
30	ND	ND
31	ND	ND

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K_i (nM)	Cytotoxicity Potentiation PF ₅₀
31a	22	ND
32	6.3	1.8
32a	8.8	ND
33	14.3	ND
34	11	1.8
35	8.2	ND
36	27	ND
37	11	1.8
38	43	ND
39	7.5	1
40	68	ND
41	54, 60	ND
42	103, 105, 107	ND
43	317, 290	ND
44	900	ND
45	167, 185	ND
46	9, 9.8	1.3
47a	121	ND
47b	809	ND
48	79	ND
49	122	ND
50	22	1.1
51	41	ND
52	79	ND
53	1800	ND
54	600	ND

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K_i (nM)	Cytotoxicity Potentiation PF_{50}
55	10	ND
56	32	ND
57	ND	ND
58	5.8	2.0
58a	4.2	ND
59	4.2	1.8
60	6.2	ND
61	6.2	ND
62	6.1	ND
63	13	ND
64	6.2	ND
65	11	ND
66	8.9	ND
67	9.3	ND
68	5.8	ND
69	ND	ND
70	4.4	ND
71	13	ND
72	3.5	ND
73	10	ND
74	33	ND
75	1.9	1.8
76	5.1	1.6
77	6.9	1.7
78	5.2	ND
79	11	ND
80	9	ND
81	ND	ND

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K _i (nM)	Cytotoxicity Potentiation PF ₅₀
82	6.2, 6.6	1.9
83	3.5, 4	ND
84	6.5, 7.1	ND
85	12, 13	ND
86	9.1	1.6
87	6.7, 7	ND
88	12, 13	ND
89	ND	ND
90	6	1.2
91	54	ND
92	200	ND
93	306	ND
93a	ND	ND
94	4.3	ND
95	6.2	ND
96	10	ND
97	1.6	ND
97a	ND	ND
98	3.3	2.1
99	1.7	2.0
100	2.7	ND
101	2.3	2.1
102	5.6	ND
103	6.2	ND
104	4.5	ND
105	6.2	ND
106	8.0	ND
107	25	ND

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K_i (nM)	Cytotoxicity Potentiation PF_{50}
108	6.0	ND
109	5.5	ND
110	18	ND
111	5.1	ND
112	18	ND
113	24	ND
114	9.9	ND
115	116	ND
116	5.2	ND
117	9.5	ND
118	4.4	ND
119	3.2, 4.2	2.2
120	7.3	ND
121	4.0	ND
122	7.0	ND
123	9.0	ND
124	8.0	ND
125	11	ND
126	4.1	2.2
127	3.5, 3.6	ND
128	4.0, 5.4	1.8
129	5.0	1.9
130	4.4, 5.6	3.4
131	22	ND
132	6.8	2.4
133	6.9	ND
134	2.8	2.5
135	3.8	ND

Compound /Example No.	Inhibition Constant K_i (nM)	Cytotoxicity Potentiation PF ₅₀
136	96	ND
137	5.4	2.2
138	11	ND
139	12	ND
140	6.8	ND
141	5.5	2.3
142	3.8	2.2
143	22	ND
144	7.4	ND
145	20	ND
146	35	ND
147	4.0	ND
148	2.8	2.5
149	4.2	2.6
150	5.0	ND
151	6.9	ND
152	3.2	ND
153	219	ND
154	ND	ND
155	87	ND
156	57	ND
157	540	ND
158	9.1	ND
159	ND	ND
160	249	ND
161	116	ND
162	ND	ND
163	692	ND

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K_i (nM)	Cytotoxicity Potentiation PF_{50}
164	606	ND
165	39	ND
166	380	ND
167	337	ND
168	38	ND
169	ND	ND
170	3.1	1.9
171	4.5	2.5
171a	ND	ND
172	4.6	ND
172d	ND	ND
173	6.3	ND
174	6.2	ND
175	6.6	ND
176	9.0	ND
177	4.1	2.5
178	12	ND
179	5.6	ND
180	7.4	ND
181	3.9	ND
182	4.7	ND
183	8.0	ND
184	6.0	2.2
185	5.6	ND
186	5.5	2.2
187	7.0	ND
188	4.8	ND
189	5.1	ND

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K _i (nM)	Cytotoxicity Potentiation PF ₅₀
190	8.1	ND
191	4.3	ND
192	4.5	ND
193	11	ND
194	6.2	ND
195	4.7, 5.9	ND
196	3.9	ND
197	2.8, 5.2	2.5
198	7.9	ND
199	6.8	ND
200	6.0	ND
201	5.8	ND
202	3.2	ND
203	4.6	2.0
204	7.9	ND
205	4.7	ND
206	6.4	ND
207	4.2	2.4
208	ND	ND
209	ND	ND
210	5.0	2.3
211	4.5	2.3
212	6.8	2.0
213	7.4	ND
214	8.3	ND
215	11	ND
216	27	ND
217	26	ND

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K_i (nM)	Cytotoxicity Potentiation PF ₅₀
218	17	ND
219	11	ND
220	4.0	ND
221	5.0	ND
221a	10.0	ND
221b	ND	ND
222	2.0, 2.3, 3.5	ND
223	8.5	2.1
224	ND	ND
225	ND	ND
226	ND	ND
227	2.2	ND
228	4.6	ND
229	5.3, 6.8	ND
229a	ND	ND
230	5.3	ND
231	6.9	ND
232	ND	ND
233	8.0	2.2
234	8.7	ND
235	5.4	ND
236	113	ND
237	5.0, 6.0	ND
237b	30	ND
237c	ND	ND
238	7.3	ND
238a	30.7	ND

TABLE 1. PARP Enzyme Inhibition and Cytotoxicity Potentiation		
Compound /Example No.	Inhibition Constant K _i (nM)	Cytotoxicity Potentiation PF ₅₀
238b	ND	ND
238c	ND	ND
239	7.8	ND
240	4.2, 4.5	ND
241	6.8	ND
242	3.4	ND
243	8.9	2.0
244	14.0	ND
245	5.8	2.1
245a	5.2, 5.3	ND
245b	ND	ND
246	3.3	2.3
247	5.4	ND
247a	10.0	ND
247b	ND	ND
247c	16.0	ND

) ND=

가

(57)

1.

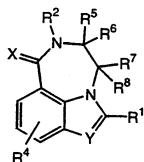
ive metabolite)

(solvate).

가

(prodrug),

(act



, X O S ;

Y N CR³,

R³ H;

;

;

-C(W)-R²⁰, W O S, R²⁰, H; OH;

H; OH;

;

-CR²⁹=N-R³⁰,

R²⁹ H

, R³⁰ H, OH

H, OH

; S- , S- , O- , O- ;

R¹ H;

;

;

C(O)R¹²,

, R¹² H;

; OR¹⁹

NR²¹ R²²,

R¹⁹, R²¹

R²²

H

OR¹³,

R¹³, H

S(O)nR¹⁶,

n 0, 1

2

, R¹⁶ H;

; NR²³ R²⁴,

, R²³ R²⁴

H

$NR^{17}R^{18}$, $R^{17}R^{18}$ H;
 ; C(O) - R^{201} , R^{201} , H; OH;
 ; O- O- ();
 R^{28} , $R^{27}R^{28}$ H, OH
 (); NR^{27}
 $(O)_2NR^{25}N^{26}$, $R^{25}R^{26}$ H
 (); S
); $S(O)_2NR^{25}N^{26}$, $R^{25}R^{26}$ H
 R^2 H ;
 R^4 H, ;
 $R^5, R^6R^7R^8$
 H;

$-C(O)R^{50}$, R^{50} H;
 ; OR^{51} $NR^{52}R^{53}$, R^{51}, R^{52}, R^{53} H
 ;
 , Y CR^3 , $R^1, R^2, R^3, R^4, R^5, R^6, R^7, R^8$ 가 H .

2.

1 가 R^1 , - ,

3.

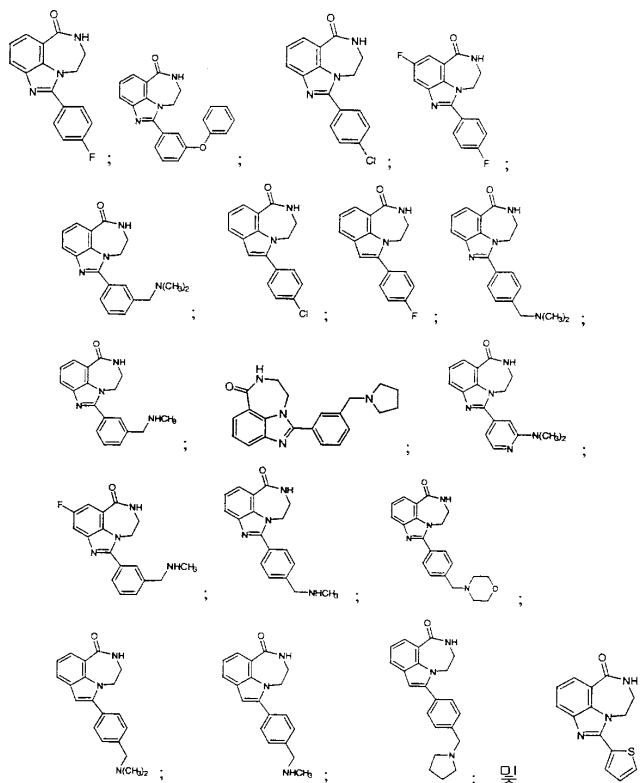
1 , R^4 H , 가 , ,

4.

1 , R^5, R^6, R^7, R^8 H , 가 , ,

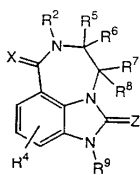
5.

1 , X , 가 , ,



11.

가



, Z O S;

R⁹ H ;

1

12.

11, R², R⁹, H, R⁴, H, R⁵, R⁶, R⁷, R⁸, H, X, 가, .

13.

(a) 1, 가, , PARP- ;

(b) PARP- 가 .

14.

1, 가, PARP, PARP

15.

14, (ADP -) (tankyrase)

16.

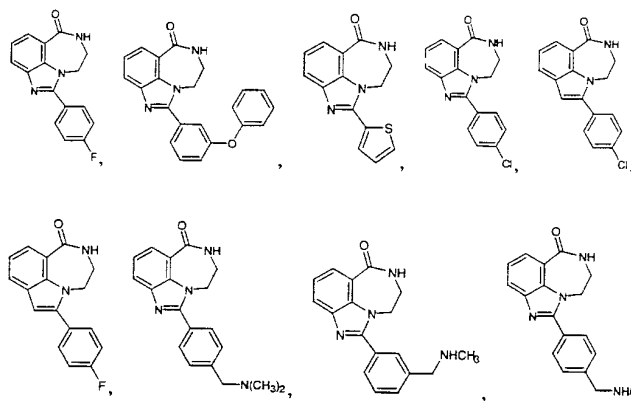
1, 가, , PARP

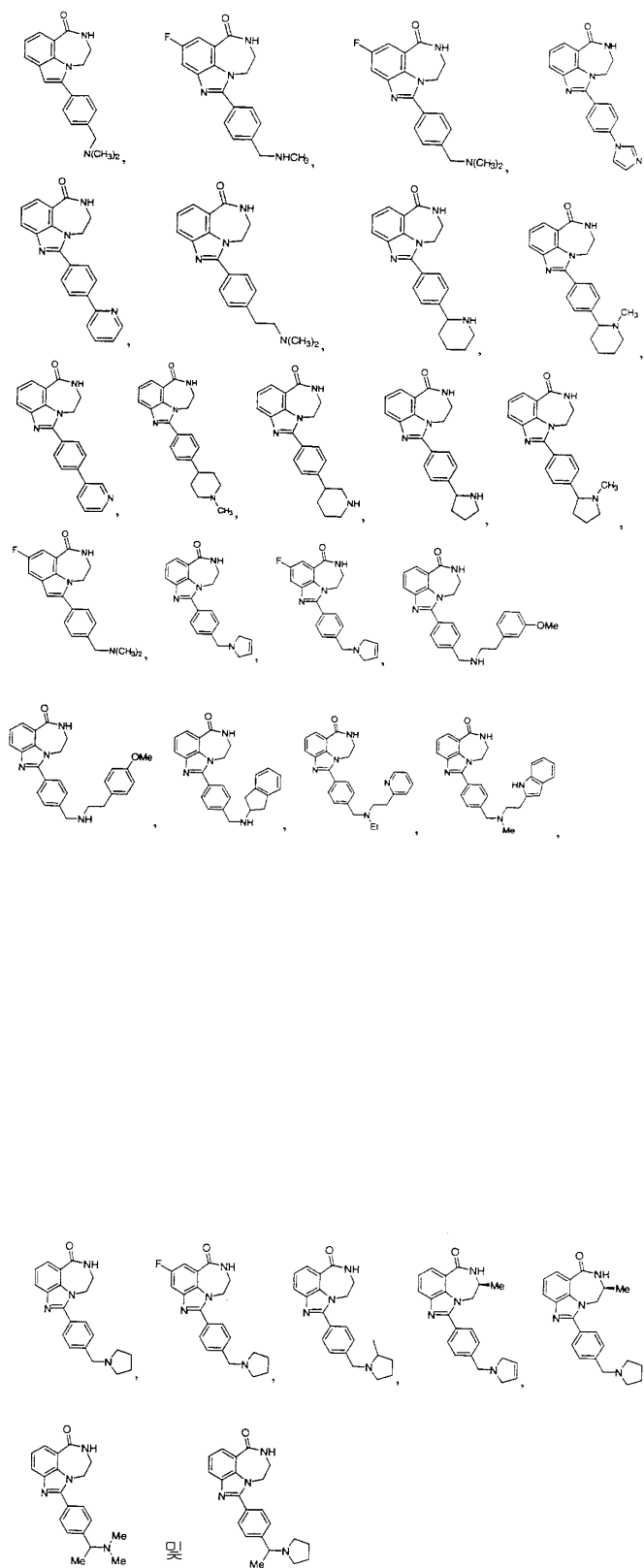
17.

11, 가, PARP, PAR

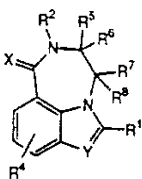
18.

1, 가, ,





1 , , 가 , , .



, X O S ;

Y N CR³,

R³ H;

;

;

, , , , , , , ; ,
 -C(W) - R²⁰ , W O S , R²⁰ , H; OH;
 , O- O- ; NR²⁷ R²⁸ , R²⁷ R²⁸
 H, OH ;

-CR²⁹ =N - R³⁰ , R²⁹ H , R³⁰ H, OH , , , , , ,
 , O- O- ; NR³¹ R³² , R³¹ R³²
 H, OH ;

R¹ H;

;

;

, , , , , , , ;
 C(O)R¹² , R¹² H; OR¹⁹ NR²¹ R²² , R¹⁹ , R²¹ R²² H ,
 ;

OR¹³ , R¹³ , H , , , , , , , ;

$S(O)nR^{16}$, $n = 0, 1, 2$, $R^{16} = H$; $NR^{23}R^{24}$, $R^{23}, R^{24} = H$;

$NR^{17}R^{18}$, $R^{17}, R^{18} = H$; $S(O)_2NR^{25}N^{26}$, $R^{25}, R^{26} = H$;

$R^2 = H$;

$R^4 = H$;

$R^5, R^6, R^7, R^8 = H$;

$-C(O)R^{50}$, $R^{50} = H$; $OR^{51}, NR^{52}R^{53}$, $R^{51}, R^{52}, R^{53} = H$;

$Y = CR^3$, $R^1, R^2, R^3, R^4, R^5, R^6, R^7, R^8$ 가 H .