

CYCLOADDITION REACTIONS WITH AZA-
BENZENES, XVIII¹
SYNTHESIS OF [2]PYRINDINES

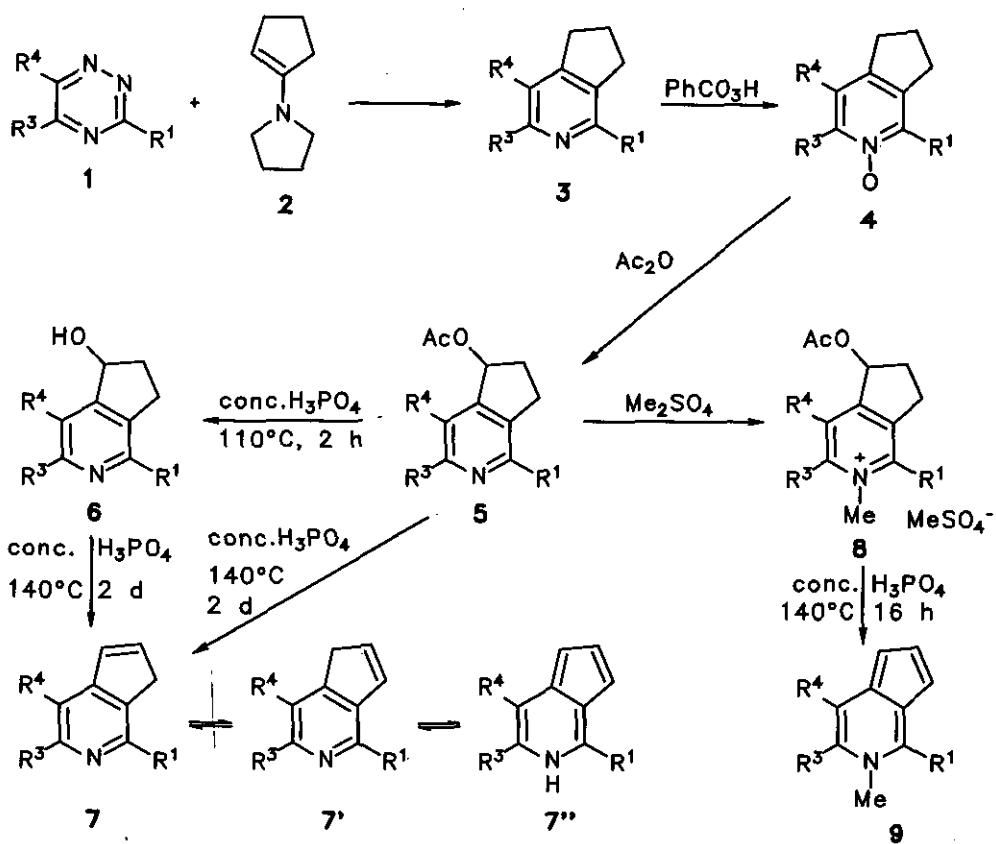
Hans Neunhoeffer*, Bernd Philipp, Birgit Schildhauer,
Ralf Eckrich, and Uwe Krichbaum

Institut für Organische Chemie der Technischen Hochschule,
Petersenstrasse 22, D-6100 Darmstadt, Germany

Abstract - The reaction of 1,2,4-triazines (1) and 1-cyclopentenylpyrrolidine (2) afforded 6,7-dihydro-5H-[2]-pyrindines (3) in good yields. Oxidation of 3 to the N-oxides (4), reaction of 4 with acetic anhydride to 5-acetoxy-6,7-dihydro-5H-[2]pyrindines (5) and elimination of acetic acid afforded [2]pyrindines (7). 2-Methyl-2H-[2]pyrindines (9) were also prepared.

Dedicated to Professor E. C. Taylor on the occasion of his 70th birthday

[2]Pyrindines (7) are not yet studied very intensively.² Better known are the 6,7-dihydro-5H-[2]pyrindines (3), because many alkaloids belong to this class of compounds.³ Since we were interested in the 6,7-dihydro-5H-[2]pyrindine alkaloids and in 2H-[2]pyrindines (7"), we studied the synthesis of these compounds by Diels-Alder reaction with inverse electron demand of 1,2,4-triazines (1) with 1-cyclopentenylpyrrolidine (2). Reactions of 1 with 2 were already reported by Sauer *et al.*⁴ and Boger *et al.*⁵ Reaction of the 1,2,4-triazines (1a-p) with 2 afforded the 6,7-dihydro-5H-[2]pyrindines (3a-p) in yields between 55% and 86%. Oxidation of 3a-1 with perbenzoic acid gave 6,7-dihydro-5H-[2]pyrindine 2-oxides (4a-1) in yields between 54% and 95%. Heating 4a-k with acetic anhydride led to the isolation of 5-acetoxy-6,7-dihydro-5H-[2]pyrindines (5a-k) in yields between 17 and 59%. Hydrolysis of 5a-d and 5g-i with H₃PO₄ and 5e with KOH afforded the 5-hydroxy-6,7-dihydro-5H-[2]pyrindines (6a-e) and (6g-i). Treatment of 5a-c or 6a-c with conc. phosphoric acid for 2 days at 140°C gave [2]pyrin-



1,3-9	a	b	c	d	e	f	g	h	i	j	k
R ¹	Ph	H	4-Tol	H	4-Tol	Ph	CO ₂ Me	CO ₂ Me	4-ClPh	H	4-Tol
R ³	Ph	H	H	Ph	H	H	Ph	Ph	CO ₂ Me	2-Furyl	CO ₂ Me
R ⁴	Ph	Ph	Ph	Ph	H	H	H	Ph	CO ₂ Me	2-Furyl	CO ₂ Me

1,3,4	l	m	n	o	p
R ¹	Me	4-Tol	4-Tol	CO ₂ Me	SMe
R ³	Ph	Ph	4-Tol	H	CO ₂ Me
R ⁴	Ph	Ph	4-Tol	Ph	CO ₂ Me

dines (7a-c). Only the 5H- (7') and 7H-tautomer (7) could be detected by nmr spectroscopy, but no 2H-tautomer (7'').

Alkylation of 5a-f with dimethyl sulfate afforded the 5-acetoxy-6,7-dihydro-2-methyl-5H-[2]pyridinium salts (8a-f). 8b-f were transformed into the 2-methyl-2H-[2]pyrindines (9b-f), when treated with conc. phosphoric acid. All compounds were characterized by their spectra and by elemental analysis.

EXPERIMENTAL

6,7-Dihydro-5H-[2]pyrindines (3a-p): Compound (2) (3.43 g, 25 mmol) was added dropwise to 1a-p (10 mmol) (neat or in 25 ml of methylene chloride) under nitrogen. The mixture was stirred for 16 h and evaporated. The residue was purified by column chromatography on silica gel with methylene chloride for 3a,c,d,g,l-n, ethyl acetate for 3b,h-k,o,p, or ether for 3e,f.

6,7-Dihydro-5H-[2]pyrindine N-oxides (4a-l): To 3a-n (10 mmol) in methylene chloride (20 ml) perbenzoic acid (20 ml) in methylene chloride (20 ml) was added. The mixture was stirred for 24 h at room temperature. To 3a,g,h,k,m,n perbenzoic acid (10 mmol) was added, and the mixture stirred for further 24 h. The methylene chloride solution of 3a,i,m,n with perbenzoic acid was heated for 5 h to reflux. The solution was washed with saturated sodium bicarbonate solution (2 x 20 ml), dried over magnesium sulfate and evaporated. The residue was purified by column chromatography on aluminum oxide with methylene chloride for 4a, chloroform for 4c,d,l, methanol for 4b, or ether for 4i. In cases of 3m and 3n, the starting material was recovered.

5-Acetoxy-6,7-dihydro-5H-[2]pyrindines (5a-k): 4a-k (10 mmol) were heated in acetic anhydride (5 ml) for 3 h to 80°C. After removal of the acetic anhydride, the residue was dissolved in ether (20 ml), washed with saturated sodium bicarbonate solution (10 ml), and dried over magnesium sulfate. Compounds (5a,g,h) were isolated by addition of hexane. In all other cases, the

etheral extract was evaporated, and the residue was purified by column chromatography on silica gel with ether for 5b, e, f, i, j, chloroform for 5c, d, or methylene chloride for 5k.

5-Hydroxy-6,7-dihydro-5H-[2]pyrindines (6a-d, g-i): 5a-d, g-i (2 mmol) were heated in conc. phosphoric acid (4 ml) under nitrogen for 2 h to 100°C. The mixture was neutralized with 6 N NaOH, diluted with water (10 ml), and extracted with ether (3 x 20 ml). The organic phases were dried over magnesium sulfate, evaporated, and the residues were purified by column chromatography on silica gel with ether for 6a, h, ether then ethyl acetate for 6i, ethyl acetate for 6b, or methylene chloride for 6d, g. Compound 6c separated on addition of water and was isolated by filtration.

5-Hydroxy-6,7-dihydro-1-(4-tolyl)-5H-[2]pyrindine (6e): To 5e (1 mmol) in methanol (5 ml) KOH (33.6 mg, 6 mmol) in methanol (10 ml) was added with stirring. After 20 h at room temperature, the mixture was evaporated, and the residue was chromatographed on silica gel column. Compound (5e) was eluted with ether, and 6e with ethyl acetate.

5-Acetoxy-2-methyl-6,7-dihydro-5H-[2]pyridinium methosulfates (8a-f): 5a-f (2.0 mmol) in dry toluene (20 ml) were stirred with dimethyl sulfate (2.0 mmol) for 1 week at room temperature. The precipitate was filtered and washed with toluene.

2-Methyl-2H-[2]pyrindines (9b-f): Compounds (8b-f) (1.0 mmol) were heated in conc. phosphoric acid (3 ml) under nitrogen for 16 h at 140°C. The mixture was poured to ice under nitrogen, and ether (25 ml) was added to the mixture. The aqueous layer was made alkaline with 6 N NaOH until pH 10. The mixture was diluted with water (30 ml) and extracted with ether (3 x 35 ml). The organic phases were dried over magnesium sulfate and evaporated.

5H- (7') and 7H-[2]Pyrindines (7a-c): Compounds (5a-c, 6a-c) (2.5 mmol) were heated with conc. phosphoric acid (5 ml) under nitrogen for 2 days at 140°C. The mixture was diluted with water (20 ml), neutralized with 5 N NaOH, and

extracted with methylene chloride (3 x 25 ml). The organic phases were dried with magnesium sulfate, evaporated and purified by column chromatography on silica gel with methylene chloride for 7/7'a, ether for 7/7'b, or chloroform for 7/7'c.

No.	yield	mp (°C)	¹ H-nmr, 60-MHz, CDCl ₃ , δ-values	formula	calcd /found		
					C	H	N
<u>3a</u>	82%	176-178 ether	1.96 (2H, quin, J=7 Hz), 2.78 (2H, t, J=7 Hz), 3.15 (2H, t, J=7 Hz), 7.21 (13H, m), 7.85 (2H, m)	C ₂₆ H ₂₁ N	89.88 89.81	6.09 6.10	4.03 4.09
<u>3b</u>	68%	59 ether	2.08 (2H, quin, J=7 Hz), 3.00 (4H, t, J=7 Hz), 7.38 (5H, s), 8.37 (2H, s)	C ₁₄ H ₁₃ N	86.12 86.10	6.71 6.64	7.17 7.14
<u>3c</u>	78%	130-132 CH ₂ Cl ₂	1.98 (2H, quin, J=7 Hz), 2.38 (3H, s), 3.04 (4H, m), 7.25 (2H, d, J=8 Hz), 7.46 (5H, m), 7.70 (2H, d, J=8 Hz), 8.52 (1H, s)	C ₂₁ H ₁₉ N	88.38 88.43	6.71 6.84	4.91 4.94
<u>3d</u>	86%	104-105 CH ₂ Cl ₂	2.05 (2H, quin, J=7 Hz), 2.92 (4H, m), 7.25 (10H, m), 8.62 (1H, s)	C ₂₀ H ₁₇ N	88.25 88.61	6.32 6.26	5.16 5.19
<u>3e</u>	67%	42 ether/ n-hexane	1.96 (2H, quin, J=7 Hz), 2.35 (3H, s), 2.95 (4H, m), 7.05 (1H, d, J=5 Hz), 7.08-7.10 (4H, m), 8.44 (1H, d, J=5 Hz)	C ₁₅ H ₁₅ N	86.08 85.80	7.22 7.20	6.69 6.64
<u>3f</u>	60%	54 ether/ n-hexane	2.02 (2H, quin, J=7 Hz), 3.00 (4H, m), 7.10 (1H, d, J=5 Hz), 7.28-7.88 (5H, m), 8.46 (1H, d, J=5 Hz)	C ₁₄ H ₁₃ N	86.12 86.23	6.71 6.69	7.17 7.13
<u>3g</u>	55%	101 ether	2.10 (2H, quin, J=7 Hz), 2.95 (2H, t, J=7 Hz), 3.26 (2H, t, J=7 Hz), 3.96 (3H, s), 7.36 (3H, m), 7.65 (1H, s), 7.93 (2H, m)	C ₁₆ H ₁₅ NO ₂	75.87 75.99	5.97 5.95	5.53 5.51
<u>3h</u>	70%	136-137 136-137 ⁴	2.03 (2H, quin, J=7 Hz), 2.76 (2H, t, J=7 Hz), 3.36 (2H, t, J=7 Hz), 3.93 (3H, s), 7.13 (10H, m)				
<u>3i</u>	88%	128-130 ether	2.15 (2H, quin, J=7 Hz), 3.15 (4H, t, J=7 Hz), 3.93 (3H, s), 3.96 (3H, s), 7.36 (2H, d, J=8 Hz), 7.70 (2H, d, J=8 Hz)	C ₁₈ H ₁₆ ClNO ₄	62.52 62.68	4.66 4.46	4.05 3.96

No.	yield	mp (°C)	¹ H-nmr, 60-MHz, CDCl ₃ , -values	formula	calcd /found		
					C	H	N
<u>3j</u>	70%	96 CH ₂ Cl ₂ / n-hexane	2.07 (2H, quin, J=7 Hz), 2.88 (2H, t, J=7 Hz), 3.00 (2H, t, J=7 Hz), 5.93-6.56 (4H, m), 7.37-7.57 (2H, m), 8.49 (1H, s)	C ₁₆ H ₁₃ NO ₂	76.48 76.68	5.22 5.24	5.57 5.47
<u>3k</u>	68%	104 ether	2.03 (2H, quin, J=7 Hz), 2.33 (3H, s), 3.06 (4H, t, J=7 Hz), 3.86 (3H, s), 3.90 (3H, s), 7.13 (2H, d, J=8 Hz), 7.60 (2H, d, J=8 Hz)	C ₁₉ H ₁₉ NO ₄	70.14 70.23	5.89 5.94	4.30 4.34
<u>3l</u>	78%	112-113 CH ₂ Cl ₂	2.04 (2H, quin, J=7 Hz), 2.06 (3H, s), 2.87 (4H, m), 7.14 (10H, m)	C ₂₁ H ₁₉ N	88.38 88.43	6.71 6.84	4.91 4.94
<u>3m</u>	83%	157-158 CH ₂ Cl ₂	2.02 (2H, quin, J=7 Hz), 2.43 (3H, s), 2.81 (2H, t, J=7 Hz), 3.20 (2H, t, J=7 Hz), 7.20 (12H, m), 7.82 (2H, d, J=8 Hz)	C ₂₇ H ₂₃ N	89.71 89.38	6.41 6.22	3.88 3.85
<u>3n</u>	77%	130-131 CH ₂ Cl ₂	1.97 (2H, quin, J=7 Hz), 2.22 (3H, s), 2.30 (3H, s), 2.35 (3H, s), 2.75 (2H, t, J=7 Hz), 3.16 (2H, t, J=7 Hz), 7.12 (10H, m), 7.82 (2H, d, J=8 Hz)	C ₂₉ H ₂₇ N	89.42 89.50	6.99 6.92	3.59 3.54
<u>3o</u>	60%	129-130 ether	2.10 (2H, quin, J=7 Hz), 3.04 (2H, t, J=7 Hz), 3.44 (2H, t, J=7 Hz), 4.04 (3H, s), 7.47 (5H, s), 8.57 (1H, s)	C ₁₆ H ₁₅ NO ₂	75.87 76.02	5.97 6.03	5.53 5.55
<u>3p</u>	61%	69-70 ether	2.13 (2H, quin, J=7 Hz), 2.60 (3H, s), 2.83 (2H, t, J=7 Hz), 3.13 (2H, t, J=7 Hz), 3.86 (3H, s), 3.93 (3H, s)	C ₁₃ H ₁₅ NO ₄ S	55.50 55.49	5.37 5.46	4.98 4.93
<u>4a</u>	48%	209-210 CH ₂ Cl ₂	1.98 (2H, m), 2.80 (4H, m), 7.18 (15H, m)	C ₂₆ H ₂₁ NO	85.92 86.16	5.82 5.87	3.85 3.83
<u>4b</u>	95%	74-75 ether	2.12 (2H, quin, J=7 Hz), 2.95 (4H, t, J=7 Hz), 7.41 (5H, m), 8.80 (2H, s)	C ₁₄ H ₁₃ NO	79.60 79.73	6.20 6.09	6.63 6.61

No.	yield	mp (°C)	¹ H-nmr, 60-MHz, CDCl ₃ , δ-values	formula	calcd /found		
					C	H	N
<u>4c</u>	82%	177-178	2.07 (2H, quin, J=7 Hz), 2.44 (3H, s), 2.94 (4H, m), 7.39 (9H, m), 8.30 (1H, s)	C ₂₁ H ₁₉ NO	83.69	6.35	4.65
		CH ₂ Cl ₂			83.72	6.33	4.60
<u>4d</u>	89%	199-200	2.10 (2H, quin, J=7 Hz), 2.86 (4H, m), 7.07 (10H, m), 8.28 (1H, s)	C ₂₀ H ₁₇ NO	83.59	5.96	4.87
		CH ₂ Cl ₂			83.86	6.04	4.89
<u>4e</u>	75%	131-132	2.07 (2H, quin, J=7 Hz), 2.40 (3H, s), 2.84 (4H, m); 6.95-7.53 (5H, m), 8.15 (1H, d, J=7 Hz)	C ₁₅ H ₁₅ NO	79.97	6.71	6.25
		MeCO ₂ Et			79.96	6.65	6.11
<u>4f</u>	77%	110 ether/ CH ₂ Cl ₂	2.07 (2H, quin, J=7 Hz), 2.86 (4H, m), 7.06 (1H, d, J=7 Hz), 7.49 (5H, s), 8.17 (1H, d, J=7 Hz)	C ₁₄ H ₁₃ NO	79.59	6.20	6.63
					79.67	6.28	6.37
<u>4g</u>	43%	149-151	2.16 (2H, quin, J=7 Hz), 2.93 (4H, t, J=7 Hz), 3.96 (3H, s), 7.33 (4H, m), 7.73 (2H, m)	C ₁₆ H ₁₅ NO ₃	71.36	5.54	4.06
		CH ₂ Cl ₂ /ether			71.55	5.63	5.20
<u>4h</u>	50%	170-172	2.10 (2H, quin, J=7 Hz), 2.75 (2H, t, J=7 Hz), 3.03 (2H, t, J=7 Hz), 4.00 (3H, s), 7.05 (10H, m)	C ₂₂ H ₁₉ NO ₃	76.50	5.54	4.06
		ether			76.60	5.60	4.04
<u>4i</u>	54%	179-180	2.11 (2H, quin, J=7 Hz), 2.86 (2H, t, J=7 Hz), 3.28 (2H, t, J=7 Hz), 3.90 (3H, s), 3.97 (3H, s), 7.46 (4H, s)	C ₁₈ H ₁₆ ClNO ₅	59.76	4.46	3.87
		methanol			59.49	4.58	3.87
<u>4j</u>	50%	161-163	2.12 (2H, quin, J=7 Hz), 2.94 (4H, m), 5.97 (1H, d, J=7 Hz), 6.40 (2H, m), 7.09 (1H, d, J=7 Hz), 7.42 (2H, m), 8.16 (1H, s)	C ₁₆ H ₁₃ NO ₃	71.90	4.90	5.24
		MeCO ₂ Et			71.68	5.01	5.19
<u>4k</u>	56%	122-124	2.10 (2H, quin, J=7 Hz), 2.40 (3H, s), 2.83 (2H, t, J=7 Hz), 3.26 (2H, t, J=7 Hz), 3.90 (3H, s), 4.00 (3H, s), 7.30 (4H, m)	C ₁₉ H ₁₉ NO ₅	66.85	5.61	4.10
		CH ₂ Cl ₂ /ether			66.99	5.66	3.99
<u>4l</u>	66%	175-176	2.08 (2H, quin, J=7 Hz), 2.53 (3H, s), 2.89 (4H, m), 7.09 (10H, m)	C ₂₁ H ₁₉ NO	83.69	6.35	4.65
		CH ₂ Cl ₂			83.57	6.14	4.61

No.	yield	mp (°C)	¹ H-nmr, 60-MHz, CDCl ₃ , δ-values	formula	calcd /found		
					C	H	N
<u>5a</u>	59%	199-200	1.70 (3H, s), 2.33 (2H, m), 3.29 (2H, m), ether 6.18 (1H, m), 7.34 (13H, m), 7.95 (2H, m)	C ₂₈ H ₂₃ NO ₂	82.94	5.72	3.45
					82.92	5.63	3.45
<u>5b</u>	48%	108-109	1.69 (3H, s), 2.50 (2H, m), 3.02 (2H, m), 6.36 CH ₂ Cl ₂ /hexane (1H, m), 7.36 (5H, s), 8.44 (1H, s), 8.52 (1H, s)	C ₁₆ H ₁₅ NO ₂	75.87	5.97	5.53
					76.09	6.05	5.46
<u>5c</u>	48%	122-123	1.72 (3H, s), 2.32 (2H, m), 2.40 (3H, s), 3.19 CHCl ₃ /hexane (2H, m), 6.38 (1H, m), 7.47 (9H, m), 8.55 (1H, s)	C ₂₃ H ₂₁ NO ₂	80.44	6.16	4.08
					80.51	6.12	4.10
<u>5d</u>	47%	218-220	1.68 (3H, s), 2.43 (2H, m), 3.12 (2H, m), 6.22 CHCl ₃ (1H, m), 7.20 (10H, m), 8.68 (1H, s)	C ₂₂ H ₁₉ NO ₂	80.25	5.78	4.25
					80.34	5.80	4.36
<u>5e</u>	43%	106-197	2.12 (3H, s), 2.41 (3H, s), 2.47 (2H, m), 3.14 ether (2H, m), 6.20 (1H, m), 7.15-7.79 (5H, m), 8.57 (1H, d, J=5 Hz)	C ₁₇ H ₁₇ NO ₂	76.38	6.41	5.24
					76.63	6.44	5.23
<u>5f</u>	42%	62-63	2.11 (3H, s), 2.45 (2H, m), 3.18 (2H, m), 6.21 ether/hexane (1H, m), 7.24-7.90 (6H, m), 8.60 (1H, d, J=5 Hz)	C ₁₆ H ₁₅ NO ₂	75.87	5.97	5.53
					76.14	5.93	5.53
<u>5g</u>	50%	116-118	2.10 (3H, s), 2.55 (2H, m), 3.40 (2H, m), 4.00 ether/hexane (3H, s), 6.20 (1H, m), 7.40 (3H, m), 7.93 (3H, m)	C ₁₈ H ₁₇ NO ₄	69.44	5.50	4.50
					69.56	5.57	4.45
<u>5h</u>	46%	115-117	1.70 (3H, s), 2.43 (2H, m), 3.43 (2H, m), 4.06 ether (3H, s), 6.26 (1H, m), 7.26 (10H, m)	C ₂₄ H ₂₁ NO ₄	74.40	5.46	3.62
					74.73	5.51	3.62
<u>5i</u>	45%	110-112	2.07 (3H, s), 2.53 (2H, m), 3.18 (2H, m), 3.87 CH ₂ Cl ₂ /hexane (3H, s), 3.97 (3H, s), 6.44 (1H, m), 7.58 (4H, m)	C ₂₀ H ₁₈ ClNO ₆	59.49	4.49	3.47
					59.22	4.43	3.52
<u>5j</u>	17%	124	1.89 (3H, s), 2.48 (2H, m), 3.02 (2H, m), 5.91- ether/hexane 6.55 (5H, m), 7.46 (2H, m), 8.60 (1H, s)	C ₁₈ H ₁₅ NO ₄	69.89	4.89	4.53
					69.98	5.03	4.43
<u>5k</u>	19%	116-117	2.10 (3H, s), 2.43 (3H, s), 2.50 (2H, m), 3.26 ether/hexane (2H, m), 3.93 (3H, s), 4.00 (3H, s), 6.50 (1H, s), 7.30 (2H, d, J=8 Hz), 7.73 (2H, d, J=8 Hz)	C ₂₁ H ₂₁ NO ₆	65.79	5.52	3.65
					65.77	5.52	3.51

No.	yield	mp (°C)	¹ H-nmr, 60-MHz, CDCl ₃ , δ-values	formula	calcd /found		
					C	H	N
<u>6a</u>	91%	168-169	1.70 (1H, s), 2.25 (2H, m), 3.33 (2H, m), 5.25 (1H, m), 7.30 (13H, m), 7.85 (2H, m)	C ₂₆ H ₂₁ NO	85.92	5.82	3.85
		CH ₂ Cl ₂			86.10	5.59	3.75
<u>6b</u>	79%	100	+) 2.12 (2H, m), 3.12 (3H, m), 5.23 (1H, m), 7.25-7.88 (5H, m), 8.41 (2H, s)	C ₁₄ H ₁₃ NO	79.59	6.20	6.63
		MeCO ₂ Et			79.52	6.25	6.63
<u>6c</u>	61%	213-214	*) 2.04 (2H, m), 2.39 (3H, s), 3.38 (3H, m), 5.07 (1H, m), 7.20-7.97 (9H, m), 8.59 (1H, s)	C ₂₁ H ₁₉ NO	83.29	6.35	4.65
		methanol			83.43	6.34	4.57
<u>6d</u>	89%	161-162	2.01 (2H, m), 2.10 (1H, s), 2.95 (2H, m), 5.15 (1H, m), 7.15 (10H, m), 8.50 (1H, s)	C ₂₀ H ₁₇ NO	83.64	5.97	4.88
		CH ₂ Cl ₂			83.52	5.82	4.79
<u>6e</u>	72%	128-129	2.10 (2H, m), 2.47 (3H, s), 2.98 (2H, m), 3.72 (1H, s), 5.15 (1H, t, J=7 Hz), 7.10-7.71 (5H, m), 8.47 (1H, d, J=5 Hz)	C ₁₅ H ₁₅ NO	79.97	6.71	6.25
		ether			79.71	6.73	6.11
<u>6g</u>	21%	115-118	") 1.98 (1H, dddd, J= 7; 8; 8.5; 13 Hz), 2.22 (1H, s), 2.61 (1H, dddd, J=3.5; 7; 8; 13 Hz), 3.16 (1H, td, J=8; 18 Hz), 3.48 (1H, ddd, J=3.5; 8; 18 Hz), 4.00 (3H, s), 5.30 (1H, t, J=7 Hz), 7.45 (3H, m), 7.94 (1H, s), 8.04 (2H, m)	C ₁₆ H ₁₅ NO ₃	71.36	5.61	5.20
		ether			71.12	5.72	5.13
<u>6h</u>	51%	89	*) 2.07 (2H, m), 3.27 (2H, m), 3.32 (1H, s), 3.88 (3H, s), 4.84 (1H, m), 7.21 (5H, s), 7.29 (5H, s)	C ₂₂ H ₁₉ NO ₃	76.50	5.54	4.06
		ether			76.31	5.50	4.17
<u>6i</u>	45%	106	+) 2.03 (2H, m), 2.80 (1H, s), 3.21 (2H, m), 3.93 (6H, s), 5.49 (1H, m), 7.42-8.02 (4H, m)	C ₁₈ H ₁₆ ClNO ₅	59.76	4.46	3.87
		ether			59.60	4.43	3.73
<u>7a</u>	95%	183-185	3.37, 3.78 (2H, t, J=2 Hz), 6.67, 6.79 (2H, m), 7.00-7.68 (13H, m), 7.89-8.20 (2H, m)	C ₂₆ H ₁₉ NO	90.40	5.54	4.06
		CH ₂ Cl ₂			90.13	5.34	4.14
<u>7b</u>	34%	85-87	3.47, 3.71 (2H, m), 6.27, 6.84 (2H, m), 7.42, 7.47 (5H, s), 8.49, 8.64 (2H, s)	C ₁₄ H ₁₁ N	87.01	5.74	7.25
		ether			87.23	5.61	7.13

No.	yield	mp (°C)	¹ H-nmr, 60-MHz, CDCl ₃ , δ-values	formula	calcd /found		
					C	H	N
<u>7c</u>	73%	156-158 °)	2.43 (3H, s), 3.59, 3.74 (2H, t, J=1.9 Hz), 6.66, 6.85 (1H, dt, J=5.6; 1.9 Hz), 7.12, 7.22 (1H, dt, J=5.6; 1.9 Hz), 7.30-7.85 (9H, m), 8.57, 8.66 (1H, s)	C ₂₁ H ₁₇ N	89.01	6.05	4.94
					88.86	6.13	4.87
<u>8a</u>	12%	230-232 *	2.29 (3H, s), 2.50 (2H, m), 3.35 (2H, m), 3.37 (3H, s), 3.94 (3H, s), 6.35 (1H, m), 7.31 (15H, m)	C ₃₀ H ₂₉ NO ₆ S	67.78	5.50	2.63
					68.03	5.23	2.55
<u>8b</u>	92%	102-103 *	1.59 (3H, s), 2.52 (2H, m), 3.22 (2H, m), 3.37 (3H, s), 4.42 (3H, s), 6.02 (1H, m), 7.57 (5H, m), 9.00 (2H, s)	C ₁₈ H ₂₁ NO ₆ S	56.98	5.58	3.69
					56.63	5.58	3.64
<u>8c</u>	79%	148-150 *	1.63 (3H, s), 2.12 (2H, m), 2.48 (3H, s), 2.85 (2H, m), 3.56 (3H, s), 4.20 (3H, s), 6.61 (1H, m), 7.46 (9H, m), 8.90 (1H, s)	C ₂₅ H ₂₇ NO ₆ S	63.95	5.80	2.98
					63.60	5.74	2.92
<u>8d</u>	80%	106-107 *	2.29 (3H, s), 2.58 (2H, m), 3.25 (2H, m), 3.38 (3H, s), 4.00 (3H, s), 6.28 (1H, m), 7.21 (10H, s), 9.26 (1H, s)	C ₂₄ H ₂₅ NO ₆ S	63.28	5.53	3.08
					63.52	5.60	2.94
<u>8e</u>	81%	90-91 *	2.11 (3H, s), 2.41 (3H, s), 2.75 (2H, m), 3.15 (2H, m), 3.37 (3H, s), 4.06 (3H, s), 6.32 (1H, m), 8.05 (1H, d, J=7 Hz), 9.05 (1H, d, J=7 Hz)	C ₁₉ H ₂₃ NO ₆ S	58.00	5.89	3.56
					58.29	5.90	3.34
<u>8f</u>	82%	110-112 *	2.12 (3H, s), 2.69 (4H, m), 3.37 (3H, s), 4.03 (3H, s), 6.37 (1H, m), 7.66 (5H, s), 8.10 (1H, d, J=7 Hz), 9.06 (1H, d, J=7 Hz)	C ₁₈ H ₂₁ NO ₆ S	56.98	5.58	3.69
					56.75	5.41	3.40
<u>9b</u>	84%	101 ether	3.76 (3H, s), 6.54-6.84 (3H, m), 7.24-7.83 (7H, m)	C ₁₅ H ₁₃ N	86.92	6.32	6.76
					86.59	6.13	6.49
<u>9c</u>	97%	130 toluene	2.44 (3H, s), 3.68 (3H, s), 6.33 (1H, m), 6.64 (1H, m), 7.02 (1H, s), 7.16-7.90 (10H, m)	C ₂₂ H ₁₉ N	88.85	6.44	4.71
					88.58	6.31	4.56

No.	yield	mp (°C)	¹ H-nmr, 60-MHz, CDCl ₃ , δ-values	formula	calcd /found		
					C	H	N
<u>2d</u>	58%	146-148 ether	3.59 (3H, s), 6.25 (1H, m), 6.78 (1H, m) 7.00-7.45 (11H, m), 8.05 (1H, s)	C ₂₁ H ₁₇ N	89.01	6.05	4.71
					88.86	5.88	4.72
<u>2e</u>	86%	87-88 ether	2.43 (3H, s), 3.55 (3H, s), 6.25 (1H, m), 6.50 (1H, m), 6.78-7.35 (7H, m)	C ₁₆ H ₁₅ N	86.84	6.83	6.33
					86.87	6.57	6.17
<u>2f</u>	79%	104-105 ether	3.61 (3H, s), 6.11-6.65 (2H, m), 6.84-7.66 (8H, m)	C ₁₅ H ₁₃ N	86.92	6.32	6.76
					86.64	6.18	6.53

*) [_D₆] DMSO +) [_D₆] acetone ") 300-MHz

REFERENCES

1. Part XVII: H. Neunhoeffler, and M. Bachmann, Liebigs Ann. Chem., 1985, 1263.
2. H.-J. Timpe and A. V. El'tsov, Adv. Heterocycl. Chem., 1983, 33, 185.
3. G. M. Strunz and J. A. Findlay, "The Alkaloids", (Ed. A. Brossi); Vol. 26, 89-183, Academic Press, New York 1985.
4. W. Dittmar, J. Sauer, and A. Steigel, Tetrahedron Lett., 1969, 5171.
5. D. L. Boger and J. S. Panek, J. Org. Chem., 1981, 46, 2179;
D. L. Boger, J. S. Panek, and M. M. Meier, J. Org. Chem., 1982, 47, 895.

Received, 7th December, 1992