PREPARATION AND REACTIONS OF 1,7-DIHYDRO-3,5-DIMETHYL-4-NITROPHENYL-1,7-DIPHENYLPYRANO[2,3-C:6,5-C]PYRAZOL-8-IUM PERCHLORATE

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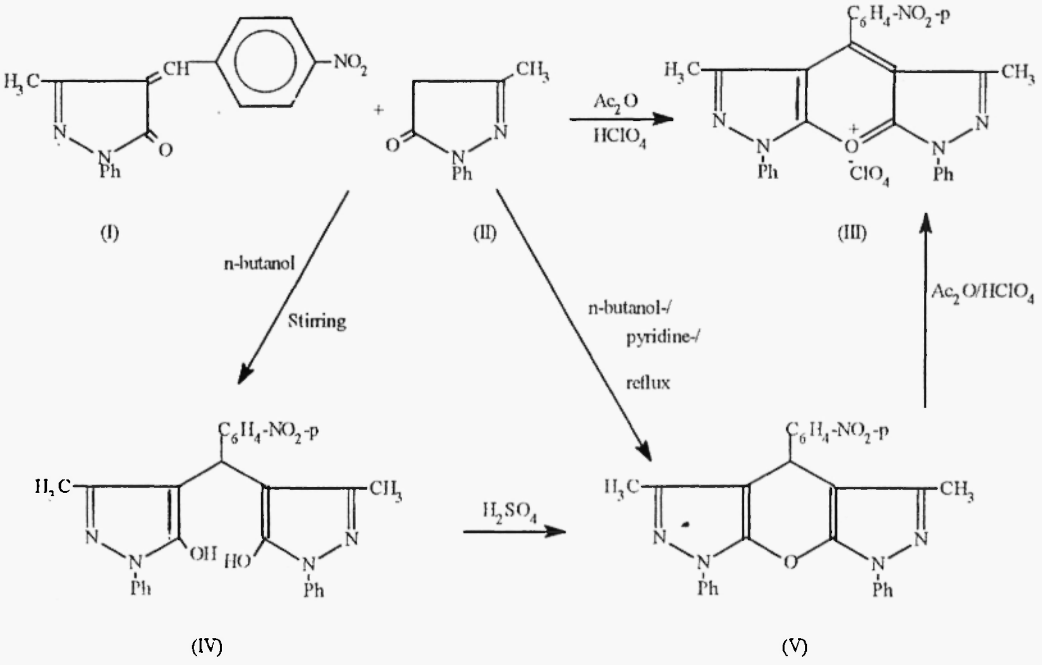
Abstract: 3-Methyl-1-phenyl-4-(4′-nitrobenzylidine)-2-pyrazolin-5-one I reacts with 3-methyl-1-phenyl-2-pyrazolin-5-one II in acetic anhydride/perchloric acid mixture to give the pyrylium salt III. Reaction of III with amines and active methylenes were studied.

In a previous paper(1) we have prepared pyrazol[5,4-b]pyrylium salts using 3-methyl-2-pyrazolin-5-one. In this paper and in continuation of our program to the synthesis of heterocyclic pyrylium salts we represent a new method to obtain 1,7-dihydro-3,5-dimethyl-4-nitrophenyl-1,7-diphenylpyrano[2,3-c:6,5-c]pyrazol-8-ium perchlorate III from 3-methyl-1-phenyl-4-(4′-nitrobenzylidine)-2-pyrazolin-5-one I and 3-methyl-1-phenyl-2-pyrazolin-5-one II in the presence of acetic anhydride/ perchloric acid mixture at 105 °C. Stirring of I and II in n-butanol gave 4-(4′-nitrobenzylidine)bis[2,4-dihydro-5-methyl-2-phenyl-3H-pyrazol-3-one] IV. On the other hand when the above reaction was carried out at reflux condition and in the presence of pyridine as a basic catalyst we obtained 4,7-dihydro-3,5-dimethyl-4-(nitrophenyl)-1,7-diphenyl-1H-pyrano[2,3-c:6,5-c]dipyrazole V. Treating of IV or V with perchloric acid/acetic anhydride mixture we obtained the pyrylium salt . III (Scheme 1, Table 1).

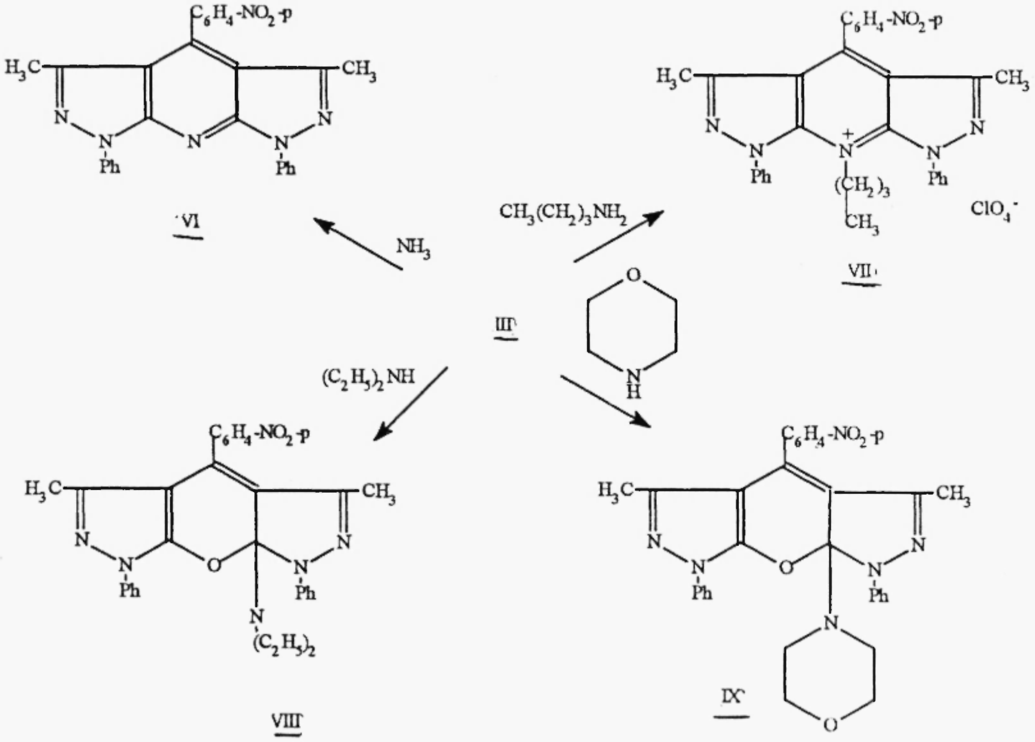


Scheme 1

Treatment of the pyrylium salt III with ammonia leads to 1,7-dihydro-3,5-dimethyl-4-(nitrophenyl)-1,7-diphenyl-dipyrazolo[3,4-b:4',3'-e]pyridine VI (2-4), through opening of the pyrylium nuclese followed by removal of water molecule. Conversion to pyridine derivatives also occurred when III was treated with butylamine to give VII (5-7), based on elemental and spectral data.

Using diethylamine or morpholine as secondary amines with the pyrylium salt III we obtained 7a-(diethylamino)-7,7a-dihydro-3,5-dimethyl-4-(nitrophenyl)-1,7-diphenyl-1H-pyrano[2,3-c:6,5-c']dipyrazole VIII and 7,7a-dihydro-3,5-dimethyl-7a-morpholino-4-(nitrophenyl)-1,7-diphenyl-1H-pyrano[2,3-c:6,5-c']dipyrazole IX (7) respectively. Structures of VIII and IX were confirmed by spectral and elemental analyses (Scheme 2, Table 2).

Treating of the pyrylium salt III with hydrazine, no pyridinium salt VII or pyranodipyrazole derivatives VIII, IX were formed and instead bis-pyrazolone derivative IV is formed, identified by spectral, elemental, m.p. and m.m.p. with an authentic sample prepared from I and II.



Scheme 2

Active methylenes e.g. malononitrile, ethyl cyanoacetate, acetylacetone, ethyl acetoacetate and 5-pyrazolone X_{a-e} were react with the pyrylium salt III in the same manner as secondary amines and gave pyrano-bis-pyrazole derivatives XI_{a-e} (cf. Sscheme 3).

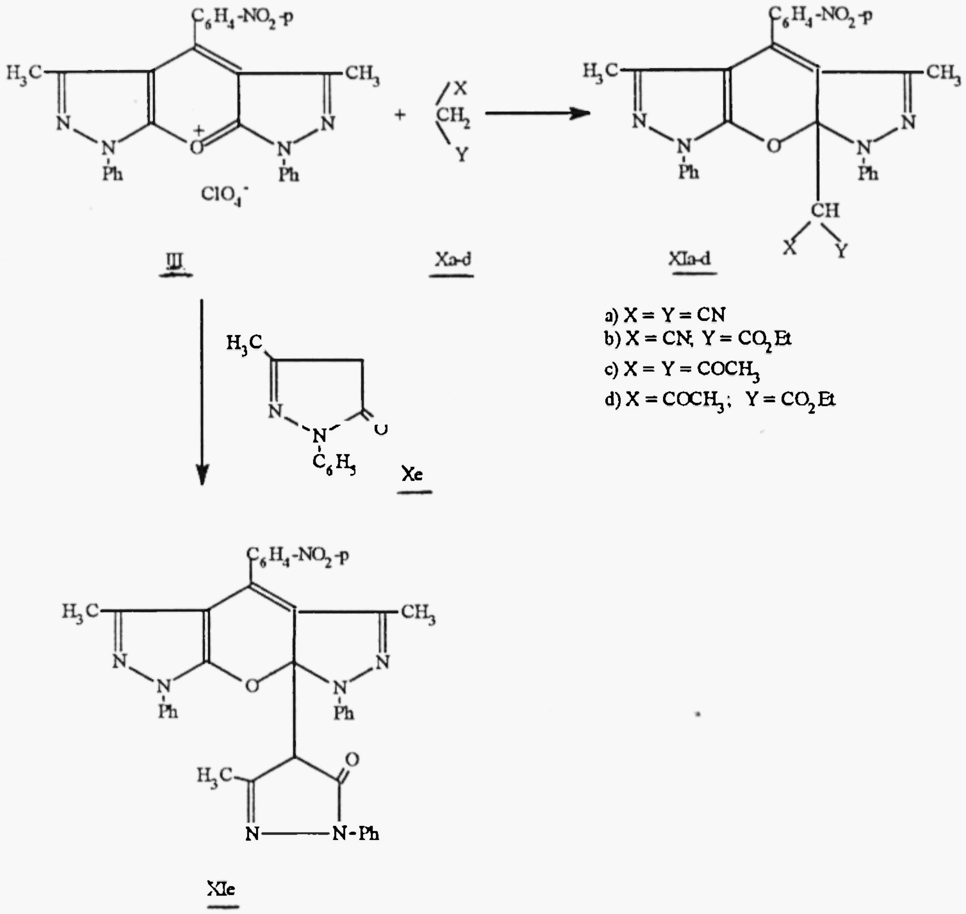
Experimental

All melting points are uncorrected. IR spectra were recorded (KBr) with 408 Shimadzo spectrophotometer. ^{1}H-NMR spectra were obtained on a Varian EM-390- 90 MHz spectrometer using TMS as internal indicator and chemical shifts are expressed as δ ppm. Analytical data were obtained at microanalysis unit at Assiut University.

1,7-Dihydro-3,5-dimethyl-4-(nitrophenyl)-1,7-diphenylpyrano[2,3-c:6,5-c] dipyrazol-8-ium perchlorate ***III***

Method A :

To a mixture of 3-methyl-1-phenyl-4-(4$'$-nitrobenzylidine)-2-pyrazolin-5-one I (1.54 g; 5 m mol) and 3-methyl-1-phenyl-2-pyrazolin-5-one II (0.87 g; 5 m mol) in 5 ml of acetic anhydride and at 105 °C, perchloric acid (3 ml) was added dropwise, the mixture was stirred for 3 h. The precipitated product by dilution with ethyl acetate was collected and dried as white amorphous (Table 1).



Scheme 3

Method B :

To 5 m mol of IV or V in 5 ml of acetic anhydride and at 105 °C, perchloric acid (3 ml) was added dropwise, the mixture was stirred for 3 h. The precipitate formed by addition of ethyl acetate was collected and dried to give white amorphous.

4-(4$'$-nitrobenzylidene)bis[2,4-dihydro-5-methyl-2-phenyl-3H-pyrazol-3-one ***IV***

A mixture of 3-methyl-1-phenyl-4(4$'$-nitrobenzylidine)-2-pyrazolin-5-one, I (1.54 g; 5 m mol) and 3-methyl-1-phenyl-2-pyrazolin-5-one, II (0.87 g; 5 m mol) in 20 ml of n-butanol was stirred for 10 h. The separated solid was collected and crystallised from ethanol to give colourless crystals.

4,7-Dihydro-3,5-dimethyl-4-(nitrophenyl)-1,7-diphenyl-1H-pyrano[2,3-c:6, 5-c]dipyrazole V

A mixture of 3-methyl-1-phenyl-4(4'-nitrobenzylidine)-2-pyrazolin-5-one I (1.54 g; 5 m mol) in 20 ml of n-butanol; 3-methyl-1-phenyl-2-pyrazolin-5-one (0.87 g; 5 m mol) and in the presence of few drops of pyridine as a catalyst was refluxed for 15 h. After cooling the precipitated product was collected and crystallised from ethanol as yellow crystals (Table 1)

1,7-Dihydro-3,5-dimethyl-4-(nitrophenyl)-1,7-diphenyldipyrazolo[3,4-b:4,3-e]pyridine VI

The pyrylium salt III (0.56 g; 1 m mol) was refluxed with 20 ml of ethanol saturated with ammonia for 4 h. The precipitated product formed after cooling was collected and crystallised from xylene to give yellow crystals (Table 2).

8-Butyl-1,7-dihydro-3,5-dimethyl-4-(nitrophenyl)-1,7-diphenyldipyrazolo-[3, 4-b:4,3-e]pyridinium perchlorate VII

To a mixture of the pyrylium perchlorate III (0.56 g; 1 m mol) and butylamine (4 m mol), sodium bicarbonate (0.67 gm in 5 ml H_2O) was added. The mixture was stirred for 15 h., then acidified to pH = 1 with perchloric acid. The formed precipitate was collected and crystallised from ethanol as brown amorphous, m.p. 166 - 170 °C; yield 0.37 g (61%).

Reaction of 1,7-dihydro-3,5-dimethyl-4-nitrophenyl-1,7-diphenylpyrano[2,3-c:6,5-c]dipyrazol-8-ium perchlorate with secondary amines

An equimolar amount of the pyrylium salt III and secondary amine (1m mol) in absolute ethanol (20 ml) was refluxed for 10 - 12 h. After cooling the precipitated product was collected and crystallised from benzene and ethanol for VIII and IX respectively.

Reaction of 1,7-dihydro-3,5-dimethyl-4-nitrophenyl-1,7-diphenylpyrano[2,3-c:6,5-c]dipyrazol-8-ium perchlorate with active methylenes

General method :

Active methylenes X_{a-e} (1 m mol) was added to a solution of 0.56 g (1 m mol) of III in 20 ml of absolute ethanol and in the presence of triethylamine as a basic catalyst (0.13 ml, 1 m mol). The reaction mixture was refluxed for 8 h. After cooling the precipitated product was collected and crystallised from proper solvent (Table 3).

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Table 1 : Physical data of the compounds III-V

Product	Yield %	m.p. °c solvent of cryst.	Molecular formula	I.R. γ (cm^{-1})	^{1}H-NMR$^{a)}$ δ (ppm)	Calc. / Found C	H	N
III	82	305 -	$C_{27}H_{20}N_5O_7Cl$ (561.9)	2900 (CH aliphatic), 3150 (CH aromatic), 1550, 1350 (NO_2)	2.6 (s, 6H, 2CH$_3$); 7.2-7.8 (m, 14H, Ar-H).	57.71 57.40	3.59 3.63	12.46 12.40
IV	69	205 - 210 ethanol	$C_{27}H_{23}N_5O_4$ (481.5)	2960 (CH, alip.), 3150 (CH, aram.), 1730 (CO), 1550, 1350 (NO_2)	2.3(s, 6H, 2CH$_3$), 4.95(s, 1H, CH), 7.2-7.9 (m, 14H, Ar-H)	67.35 67.36	4.81 5.19	14.54 14.40
V	70	229 ethanol	$C_{27}H_{21}N_5O_3$ (463.5)	3050 (CH arom.), 2900 (CH aliph.), 1580, 1340 (NO_2)	2.6 (s, 6H, 2CH$_3$), 5.4 (s, 1H of pyran) 7.2-7.85 (m, 14H, Ar-H)	69.97 70.22	4.57 4.32	15.11 15.33

a) ^{1}H-NMR for III and IV were carried out in DMSO, for V in TFA.

Table 2 : Physical data of compounds VI-IX.

Product	Yield %	m.p. °c solvent of cryst.	Molecular formula	I.R. γ (cm^{-1})	^{1}H-NMR$^{a)}$ δ (ppm) (DMSO)	Calc. / Found C	H	N
VI	61	224-25 xylene	$C_{27}H_{20}N_6O_2$ (460.5)	3050 (CH arom.), 2950 (CH aliph) 1550, 1350 (NO_2)	-	70.42 70.05	4.38 5.08	18.25 18.21
VII	61	166-170 benzene	$C_{31}H_{29}N_6O_6Cl$ (617.1)	3050 (CH arom.), 2900 (CH aliph.), 1530, 1340 (NO_2)	-	60.34 60.21	4.74 4.52	13.62 13.50
VIII	57	127-130 benzene	$C_{31}H_{30}N_6O_3$ (534.6)	3080 (CH arom.), 2950 (CH aliph.), 1560, 1360 (NO_2)	-	69.65 69.24	5.66 6.29	15.72 15.43
IX	65	160-165 ethanol	$C_{31}H_{28}N_6O_4$ (548.6)	3050 (CH arom.), 2900 (CH aliph.), 1550, 1350 (NO_2)	1.35(s, 6H, 2CH$_3$), 2.25(s, 4H, 2CH$_2$), 2.55 (s, 2H, CH$_2$), 3.5 (s, 2H, CH$_2$), 7.0-8.1 (m, 14H, Ar-H).	67.87 67.78	5.14 5.12	15.32 15.14

Table 3 : Physical data of the compounds XIa-e

Product	Yield %	m.p. °c solvent of cryst.	Molecular formula	I.R γ (cm^{-1})	^{1}H-NMR$^{a)}$ δ (ppm)	Calc. / Found		
						C	H	N
XIa	77	217-220 ethanol	$C_{30}H_{21}N_7O_3$ (527.5)	3050 (CH arom.), 2900 (CH aliph.), 1580, 1340 (NO_2)	2.0 (s, 6H, 2CH_3), 4.65 (s, 1H, CH), 7.0-8.0 (m, 14H, Ar-H)	68.30 68.21	4.01 4.21	18.59 18.51
XIb	70	215 ethanol	$C_{32}H_{26}N_6O_5$ (574.6)	3100 (CH arom.), 2930 (CH aliph.), 1580, 1350 (NO_2) 1550, 1350 (NO_2)	1.1-1.35(t, 3H, CH_3), 2.35(s, 6H, 2CH_3), 3.5-3.85(q, 2H, CH_2), 5.0 (s, 1H, CH), 7.35-8.25 (m, 14H, Ar-H)	66.89 66.72	4.56 4.52	14.63 14.81
XIc	66	220 ethanol	$C_{32}H_{27}N_5O_5$ (561.6)	3070 (CH arom.), 2950 (CH aliph.), 1600, 1380 (NO_2)	2.3 (s, 6H, 2CH_3), 2.6 (s, 6H, OCH_3), 5.1(s, 1H, CH), 7.2-8.15 (m, 14H, Ar-H)	68.44 68.24	4.85 4.73	12.47 12.61
XId	59	147-150 toluene	$C_{33}H_{29}N_5O_6$ (591.6)	3050 (CH arom.), 2900(CH aliph.), 1720(CO) 1560, 1350 (NO_2)	1.2-1.4(t, 3H, CH_3), 2.25(s, 6H, 2CH_3), 3.0-3.25(q, 2H, CH_2), 4.9(s, 1H, CH), 7.15-8.15 (m, 14H, Ar-H).	66.99 66.94	4.94 4.80	11.84 11.69
XIe	64	198-200 ethanol	$C_{37}H_{25}N_7O_4$ (635.7)	3050 (CH arom.), 2900 (CH aliph.), 1560, 1340 (NO_2)	2.2 (s, 6H, 2CH_3), 2.4 (s, 3H, CH_3), 4.9(s, 1H, CH of pyrazole), 7.0-8.0 (m, 19H, Ar-H).	69.91 69.82	4.99 4.80	15.42 15.51

a) ^{1}H-NMR for XIa-d were carried out in $CDCl_3$, for XIe in DMSO.

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