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Synthesis and Characterization of Some New Dianiline oxides.

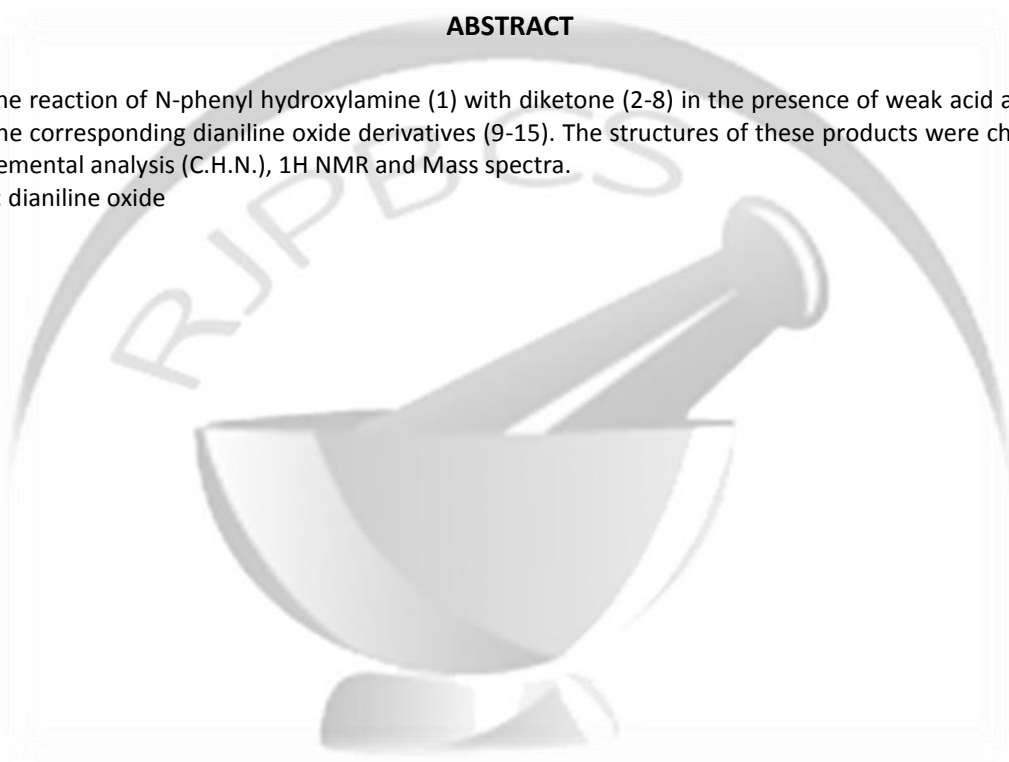
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ABSTRACT

The reaction of N-phenyl hydroxylamine (1) with diketone (2-8) in the presence of weak acid as a catalyst afforded the corresponding dianiline oxide derivatives (9-15). The structures of these products were characterized by their elemental analysis (C.H.N.), ¹H NMR and Mass spectra.

Keywords: dianiline oxide

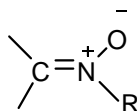


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INTRODUCTION

The "nitrone" is an abbreviation which was suggested by Pfeiffer (Pfeiffer, 1916) in 1916 for compounds containing the functional group, as shown below.



R = H, alkyl, aryl, etc.

The name emphasizes its similarity with ketone and aldehyde which were suggested to indicate a chemical relationship between nitrones and the carbonyl compounds (Smith, 1938), as shown in scheme (1).

The chemistry of nitrones was previously reviewed by Smith in 1938 as one of the structural systems which undergo 1, 3-addition reactions (Smith, 1938; Pfeiffer, 1916)

From their early discovery until the present time, nitrones were quite versatile intermediates in organic synthesis and have proved to be very useful tools in the construction of structurally complex molecules, usually allowing a high degree of diastereocontrol (Kano et al., 2005; Banerji, 2004); for instance, they are employed in stereo selective formation of synthetically useful isoxazolidines by their 1,3-dipolar cycloaddition with alkene (Banerji and Sengupta, 2001). In addition, the alkylation of nitrones by organometallic reagents has been extensively developed and has become a reliable synthetic procedure (Meino et al., 2000; Meino et al., 2001).

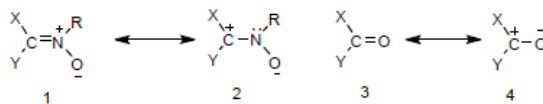
They are also used in the synthesis of many-nitrogen-containing biologically active compounds (Barbati et al., 1997). Also, some nitrones have been used for the trapping and identification of free radicals, particularly in biological studies (Zink et al., 2000; David et al., 2002; Hawkins and Davies, 2002).

There are two types of nitrones, aldonitrones and ketonitrones. Aldonitrones contain a proton on the α -carbon atom, $R_1CH=N(O)R_2$, while in the second type of nitrones, ketonitrones, the α -carbon is fully substituted by alkyl and/or aryl group, $RR_1C=N(O)R_2$. Usually for cyclic nitrones (Hamer and Macaluso, 1964; Breuer, 1982), the names are in accordance with the parent heterocyclic structure.

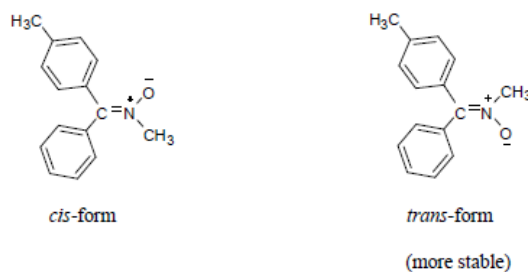
Nitrones exhibit geometric isomerism because of the double bond in the nitrone group (Torssell, 1988; Breuer, 1989), as shown in scheme (2).

Ultraviolet spectral studies indicate that aldonitrones exist in the stable *trans* form (Peter and David, 1996).

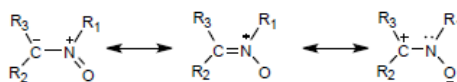
All these azomethine-N-oxide groups are dipolar in character and the typical nitron reactions depend on this character. The polarization of the azomethine-N-oxide group is moderated by the inductive or mesomeric effect of the substituents R_1 , R_2 and R_3 , as shown in scheme (3) (Breuer, 1982).



Scheme (1)



Scheme (2)



Scheme (3)

Experimental

General

Melting points were uncorrected. NMR spectra were acquired with a Bruker Ultra Shield (300 MHz). The chemical shifts were referenced to tetra methyl silane (TMS) as an internal standard. GC mass spectra were acquired with Shimadzu Qp5050A.

Synthesis of Dianiline Oxide

General procedure

In a 100 ml round flask, (2.18g, 0.02 mole) of N-phenyl hydroxylamine (which was prepared as mention in the literature) (Vogel, 1956) and 11 ml of suitable solvent (Table (1)) were stirred and warmed to 50°C. An additional 5 ml of solvent was added slowly to completely dissolve the N-Phenyl hydroxylamine. A solution of (0.01mole) of diketones and (0.1 g) of p-toluene sulphonic acid was added to the mixture. Then the mixture was refluxed for (4-8)

hours, and cooled to 0°C and kept in this temperature for overnight, the crude dinitrone products were filtered and dried in a vacuum. Table (1) shows the used solvent, temperature, weight of diketone and time of the reactions.

Then, recrystallisation of the products was performed by using dry toluene and resulted in different coloured crystals which were purified by column chromatography by using (benzene: methanol) with ratio (8:2) as eluent. Different coloured crystals with different melting points, were obtained. The purity of the synthesized compounds was determined by using Thin Layer Chromatography (T.L.C.) with eluante (benzene: methanol) ratio (8:2) respectively, as shown in table (2).

Table (1) Diketone compounds, solvent used, temperature, weight and time of synthesis of dinitrone compounds

Diketone compounds	Solvent used	The solvent used to dissolve N-Phenylhydroxylamine	Reaction temperature	Weight of diketone(g)	Reaction time (hour)
p-Benzoquinone	Absolute ethanol	Absolute ethanol	78°C	1.08	4
9,10-anthraquinone	Dry Benzene	Dry Benzene	81°C	2.08	5
Acenaphthaquinone	Dry Benzene	Dry Benzene	81°C	1.82	7
2-methyl-1,3-cyclopentandione	Absolute ethanol	Absolute ethanol	78°C	1.12	4
1,3- Indandione	Absolute ethanol	Absolute ethanol	78°C	1.46	4
2-methyl-1,3-cyclohexanedione	Absolute ethanol	Absolute ethanol	78°C	1.26	4
1,2-Naphthaquinone	Absolute ethanol	Absolute ethanol	78°C	1.58	7

Table (2) : Some physical data of dinitrone compounds

Symbol of dinitrone	Color	Melting point (°C)	Reaction Time(h)	Yield (%)	R _f
N ₁	Yellow	36	5	92	0.93
N ₃	Pale red	34	6	88	0.90
N ₅	Yellow	36	6	76	0.92
N ₈	Yellow	36	4	93	0.96
N ₁₁	Yellow	36	5	94	0.90
N ₁₂	Yellow	38	4	94	0.96
N ₁₃	Yellow	36	8	60	0.93

N,N'-(cyclohexa-2,5-diene-1,4-diylidene) dianiline oxide (9):

From p-benzoquinone (2) (1.08 g) yield 92%; m.p. 36oc; FT-IR ν (cm⁻¹)1586 cm⁻¹ (C=N)stretching; 1159 cm⁻¹ (N-O)stretching ; 1288 cm⁻¹ (C-N)stretching. δ H(DMSO) 6.590 ppm (s,4H, cyclohexa-2,3,4,5-tetraene); (7.220-7.240) ppm (d,2H,para ArH of N-phenyl group); (8.230-8.275) ppm (t,4H,meta ArH of N-phenyl group);(9.000-9.025) ppm (d,4H,ortho ArH of N-phenyl group). m/z= 290 [M⁺]. Anal. Calc. for C₁₈H₁₄N₂O₂ (290); C, 74.482; H, 4.827; N, 9.655 Found; C, 74.400; H, 4.825; N, 9.654.

N,N'-(anthracene-9,10-diylidene) dianiline oxide (10):

From 9,10-anthraquinone (3) (2.08 g) yield 88%; m.p. 34oc; FT-IR ν (cm⁻¹)1583cm⁻¹ (C=N)stretching; 1161 cm⁻¹ (N-O)stretching ; 1328 cm⁻¹ (C-N)stretching. δ H(DMSO) merge with ArH (d,2H,para ArH of N-phenyl group); (8.255-8.298)ppm (t,4H,meta ArH of N-phenyl group); (9.020-9.040)ppm (d,4H,ortho ArH of N-phenyl group); (7.503-7.680)ppm (m,6H,ArH). m/z= 390 [M⁺]. Anal. Calc. for C₂₆H₁₈N₂O₂ (390); C, 80.000; H, 4.615; N, 7.179; Found; C, 79.903; H, 4.614; N, 7.177.

N,N'-(acenaphthalene-1,2-diylidene) dianiline oxide (11):

From Acenaphthaquinone (4) (1.82 g) yield 76%; m.p. 36oc; FT-IR ν (cm⁻¹) 1591 cm⁻¹ (C=N)stretching; 1163cm⁻¹ (N-O)stretching ; 1328cm⁻¹ (C-N)stretching. δ H(DMSO) merge with ArH (d,2H,para ArH of N-phenyl group); (8.260-8.310) ppm (t,4H,meta ArH of N-phenyl group); (9.000-9.020)ppm (d,4H,ortho ArH of N-phenyl group); (7.448-7.803)ppm (m,6H,ArH). m/z= 364 [M⁺]. Anal. Calc. for C₂₄H₁₆N₂O₂ (364); C, 79.120; H, 4.395; N, 7.692; Found; C, 79.020; H, 4.391; N, 7.690.

N,N'-(2-methyl cyclopentane-1,3-diylidene) dianiline oxide (12):

From 2-methyl-1,3-cyclopentandione (5) (1.12 g) yield 93%; m.p. 36oc; FT-IR ν (cm⁻¹) 1602 cm⁻¹ (C=N)stretching; 1161 cm⁻¹ (N-O)stretching ; 1328 cm⁻¹ (CN) stretching. δ H(DMSO) (7.220-7.240)ppm (d,2H,para ArH of N-phenyl group); (8.220-8.265)ppm (t,4H,meta ArH of N-phenyl group); (9.000-9.025)ppm (d,4H,ortho ArH of N-phenyl group); 1.815ppm (q,1H,CH); 1.590ppm (s,4H,CH₂); 0.465ppm (d,3H,CH₃). m/z= 294 [M⁺]. Anal. Calc. for C₁₈H₁₇N₂O₂ (294); C, 73.469; H, 6.122; N, 9.523; Found; C, 73.459; H, 6.120; N, 9.520.

N,N'-(indane-1,3(2H)-diylidene) dianiline oxide (13):

From 1,3- Indanedione (6) (1.46 g) yield 94%; m.p. 36oc; FT-IR ν (cm⁻¹)1602 cm⁻¹ (C=N)stretching; 1159 cm⁻¹ (N-O)stretching ; 1326 cm⁻¹ (CN) stretching. δ H(DMSO) merge with ArH (d,2H,para ArH of N-phenyl group); (8.200-8.245)ppm (t,4H,meta ArH of N-phenyl group) ; (9.000-9.020)ppm (d,4H,ortho ArH of N-phenyl group); (7.460-7.651)ppm (m,6H,ArH); 1.420 ppm (s,2H,CH₂). m/z= 328 [M⁺]. Anal. Calc. for C₂₁H₁₆N₂O₂ (328); C, 76.829; H, 4.878; N, 8.536; Found; C, 76.759; H, 4.876; N, 8.533.

N,N'-(1-methyl cyclohexane-1,3-diylidene) dianiline oxide (14):

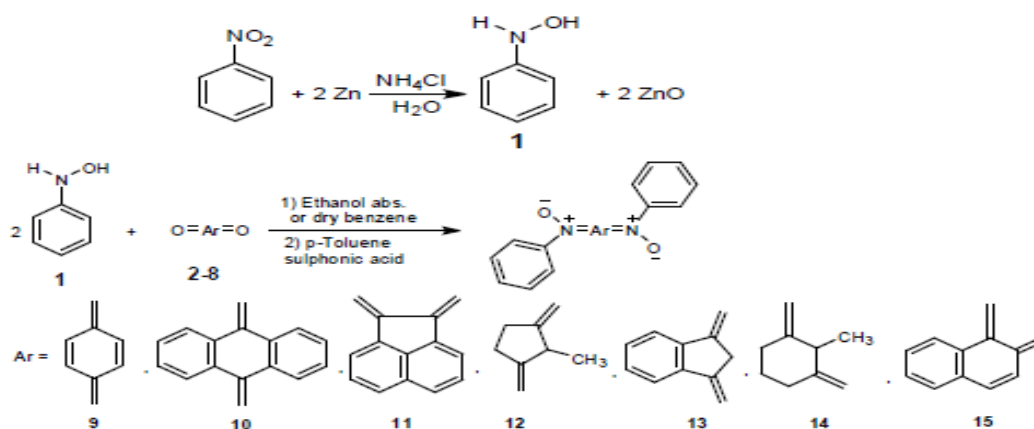
From 2-methyl-1,3-cyclohexanedione (7) (1.26 g) yield 94%; m.p. 38oc; FTIR ν (cm⁻¹) 1586 cm⁻¹ (C=N)stretching; 1163 cm⁻¹ (N-O)stretching ; 1328 cm⁻¹ (CN) stretching. δ H(DMSO) (7.220-7.240)ppm (d,2H,para ArH of N-phenyl group); (8.220-8.260)ppm (t,4H,meta ArH of N-phenyl group); (9.000-9.020)ppm (d,4H,ortho ArH of N-phenyl group); 1.825ppm (quar,1H,CH); 1.300 (t,4H,CH₂ in position 4,6); 1.580ppm (quin,2H,CH₂ in position 5); 0.465ppm (d,3H,CH₃). m/z=308 [M⁺]. Anal. Calc. for C₁₉H₁₉N₂O₂ (308); C, 74.025; H, 6.493; N, 9.090; Found; C, 74.000; H, 6.492; N, 9.089.

N,N'-(naphthalene-1,2-diylidene) dianiline oxide (15):

From 1,2-Naphthaquinone (8) (1.58 g) yield 60%; m.p. 36oc; FT-IR ν (cm⁻¹) 1602 cm⁻¹ (C=N)stretching; 1161 cm⁻¹ (N-O)stretching ; 1328 cm⁻¹ (CN) stretching. δ H(DMSO) merge with ArH (d,2H,para ArH of N-phenyl group); (8.200-8.245) ppm (t,4H,meta ArH of N-phenyl group); (9.000-9.020) ppm (d,4H,ortho ArH of N-phenyl group); (7.460-7.651)ppm (m,4H,ArH in position5,6,7,8); (5.300-5.320) ppm (d,1H,ArH in position3); (7.900-7.920) ppm (d,1H,ArH in position 4);1.825ppm (quar,1H,CH); 1.300ppm (t,4H,CH₂ in position 4,6). m/z=340 [M⁺]. Anal. Calc. for C₂₂H₁₆N₂O₂ (340); C, 77.647; H, 4.705; N, 8.235; Found; C, 77.547; H, 4.703; N, 8.234.

RESULTS AND DISCUSSION

Treatment of the N-phenylhydroxylamine (1) with diketones (2-8) in the presence of p-toluene sulphonic acid as catalyst in boiling ethanol gave, after purification from recrystallization or short column of silica gel, the pure *trans* dianiline oxide derivatives (9-15) in 60-94% yield, as crystalline compounds (scheme 4).The structures of these products were established from their elemental analysis, FT-IR,1H NMR and Mass spectra. The FT-IR spectra are represented in figures (1-7).


Scheme (4)

All IR spectra of these compounds showed a strong infrared absorption band in the region between (1159-1161) cm^{-1} due to N+-O- stretching. Other weak bands appeared in the region (1583-1602) cm^{-1} which were characteristic of all dianiline oxide compounds and were due to the C=N stretching. Also, medium absorption bands appeared between the region (1288-1328) cm^{-1} due to C-N stretching. The ^1H NMR spectra are represented in figures (8-14). All the ^1H NMR spectra were characterized (Silverstien et al., 2005; Cooper, 1980; Shriner and Hermann, 2004) by the presence of protons of aromatic rings system which appeared at $\delta = (7.448-7.803)$ ppm. The protons of N-phenyl groups showed triplet signal in the region (8.200- 8.310) ppm due to the protons at 2' position. The other protons at 1' position for this group showed doublet signal within the range (9.000-9.040) ppm because of the high electronegativity of the nitron group (-C=N+-O-). While, the protons at 3' position for this group showed doublet signal within the range (7.220-7.240) ppm. The mass spectra are represented in figures (15-21). The mass spectra of dianiline oxide (Hem and Hultin, 2005; Frigerio, 1974; Rose and Jonstone, 1982) showed the peaks at ($m/z=290,390,364,294,328,308$ and 340) which represented the molecular ion $[M^+]$ of (9-15) compounds, respectively.

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