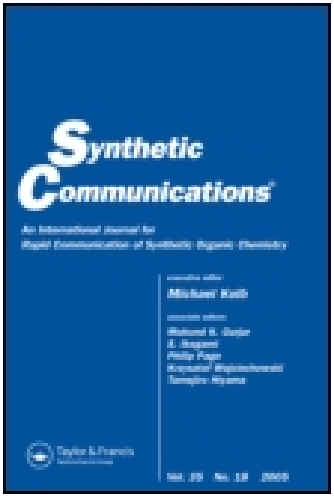

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A New Synthesis of Quinoline-5,8-Quinone

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A NEW SYNTHESIS OF QUINOLINE-5,8-QUINONE

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Abstract: Sensitised photo-oxidations of 8-hydroxy quinoline (**1**) or 5-hydroxy quinoline (**2**) gives quinoline-5,8-quinone (**3**) in 64-70% yield.

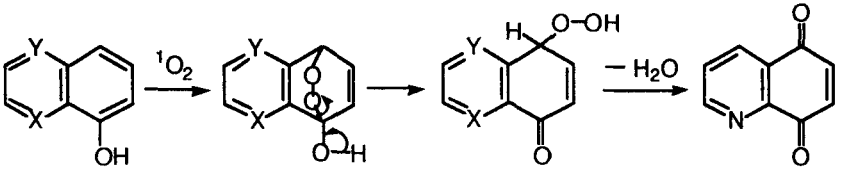
Quinoline-5,8-quinone (**3**) is an important synthetic intermediate in the synthesis of a variety of biologically active compounds and azaanthraquinones[1]. A number of biologically interesting compounds, including the antitumor antibiotics streptonigrin and lavendamycin,[2] are derivatives of quinoline-5,8-quinone. The common method of preparation of quinoline-5,8-quinone (**3**) is the oxidation of the readily available 8-hydroxy quinoline (oxine) (**1**). The only direct oxidation reported,[3] using sodium nitrite, gives **3** in very low yield, and the standard method is the conversion of **1** into 5-amino,8-hydroxy quinoline or 5,8-dihydroxyquinoline before the oxidation. For this purpose 8-hydroxyquinoline is first converted to the 5-niroso-, nitro-, or arylazo derivative by reacting with nitrous acid, nitric acid or sulphanilic acid diazonium chloride[4,5]. Any of these derivatives can then be reduced to give the 5-amino compound, and a number of reducing agents can be employed

for this, including stannous chloride and hydrogen-Raney nickel. The most frequently used method for the oxidation of 5-amino,8-hydroxy quinoline or 5,8-dihydroxyquinoline is the use of sodium dichromate in sulphuric acid, and this usually gives a yield in the range of 30-40%[5]. The overall yield from **1** via any of these multi step routes is typically in the range of 10-20%. The photosensitised oxidation of phenols has gained interest in recent years as a useful reaction[6]. Cyclic peroxides are formed by the cycloaddition of singlet oxygen to activated aromatic rings, and these adducts are known to undergo interesting rearrangements and eliminations to yield quinones and other oxidation products[7]. Griffiths has shown that this type of reaction can be extended to some naphthols as well, producing 1,4-naphthoquinones via sensitised photo-oxidation[8]. It was found that a methylene blue sensitised photo-oxidation method can be employed efficiently to by-pass the three-step route in the oxidation of 8-hydroxyquinoline (**1**) to quinoline 5,8-quinone (**3**). Photo-oxidation is most effective when the reaction mixture is cooled to 10-15°C. The reaction rate rapidly decreases above this temperature, and no oxidation was found at room temperature and above. The only isolable product formed is quinoline-5,8-quinone, oxidation in the heterocyclic ring and 1,2-quinone formation was not observed, and only small amount of resinous material (< 5%) is formed and which can be easily removed by treatment with activated charcoal and recrystallisation. Most probably the reaction proceeds via the addition of singlet oxygen to the phenolic ring in a [4+2] cycloaddition and cleavage of the hydroperoxide with the elimination of water as shown. Photoxidation of 5-hydroxyquinoline (**2**) under the same reaction conditions gave **3** in 64% isolated yield, showing the generality of the method in the preparation of **3**.

Photo-oxidation of 8-hydroxy quinoline to quinoline-5,8-quinone:

8-Hydroxy quinoline (0.725g, 5mmol) was dissolved in 500cm^3 of the solvent

mixture containing methylene chloride and methanol (4:1), and a trace of methylene blue was added to give a deep blue colour. The solution was then cooled to 15°C and irradiated with visible light using a tungsten filament lamp (200W), while a constant stream of oxygen was bubbled through the solution. The reaction was monitored by TLC (Silica, Ethylacetate : hexane 1:2) and irradiation was stopped after complete disappearance of the 8-hydroxyquinoline (8-10hrs). Then the solution was treated with small amount of activated charcoal and filtered. The filtrate was evaporated to dryness under reduced pressure and the residue was recrystallised from ethylacetate - hexane to give pure quinoline-5,8-quinone as a yellow powder, (0.554g, 70% yield). m.p.127-9°C (decomp.) (lit[3]. m.p. 129°C, decomp.). ^{1}H NMR ($CDCl_3$, 200MHz) δ 7.08 (1H, d, J=10.0Hz); 7.19(1H, d, J=10.0Hz); 7.72(1H, dd, J=4.3,7.8Hz); 8.45(1H, dd, J=1.5,7.8Hz); 9.08(1H, dd, J=1.5,4.3Hz); ^{13}C NMR ($CDCl_3$) δ 127.9, 129.1, 134.6, 138.0, 139.1, 147.4, 154.8, 183.2, 184.5



3

1 X = N , Y = CH

2 X = CH , Y = N

In conclusion this method allows an easy and straight forward preparation of the quinoline 5,8-quinone (**3**) in gram quantities from commercially available 8-hydroxy quinoline (**1**) or 5-hydroxy quinoline(**2**) in good yield and short time.

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