

New Synthesis of 2-Alkoxy-5-methyl-1,4-benzoquinones
by the Oxidation of 4-Methylcatechol with Copper(II)
Chloride in Alcohols

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4-Methylcatechol was oxidized with copper(II) chloride
in various alcohols under oxygen to give the corresponding
2-alkoxy-5-methyl-1,4-benzoquinones.

Recently much attention has been focused on chemistry of copper-mediated oxidation from the viewpoints of synthetic reagents and biomimetic reaction.^{1,2)} In the previous paper,³⁾ we have reported copper(II)-based phenol oxidation system. On the other hand, alkoxy 1,4-benzoquinones are also of interest in their connection with naturally occurring compounds such as ubiquinone.⁴⁾ Singh and Turner reported the synthesis of alkoxy-1,4-benzoquinone from alkyl-1,4-benzoquinone with zinc chloride in low yield and the products were 2-alkoxy-5-alkyl- and 2-alkoxy-6-alkyl-1,4-benzoquinone mixtures.⁵⁾ However, no easy and simple method for the preparation of alkoxy-1,4-benzoquinones from catechols has been known. We now find that oxidation of 4-methylcatechol by copper(II) chloride in various alcohols gives the corresponding 2-alkoxy-5-methyl-1,4-benzoquinone in good yield. This synthetic process could be useful because of its simplicity.

4-Methylcatechol (1) (4.0 mmol) in alcohol (50 cm³) was oxidized with anhydrous copper(II) chloride (4.0 mmol) at 60 °C under oxygen bubbling for 20 h to give the corresponding 2-alkoxy-5-methyl-1,4-benzoquinone (2a-2d) as in Table 1. Using t-butanol as solvent, starting material was only recovered. In order to make clear the intermediate of this reaction, 4-methylcatechol (1) was treated with copper(II) chloride in methanol under argon bubbling to give 2-methoxy-5-methylphenol (71% yield),⁶⁾ which was easily oxidized to the compound 2a (100% yield)⁷⁾ in the system of copper(II) chloride-oxygen-alcohol. This indicates that one hydroxy group of catechol was substituted by alkoxy group with cupric ion at first and then, the para-position of free hydroxyl group of the catechol was oxidiz-

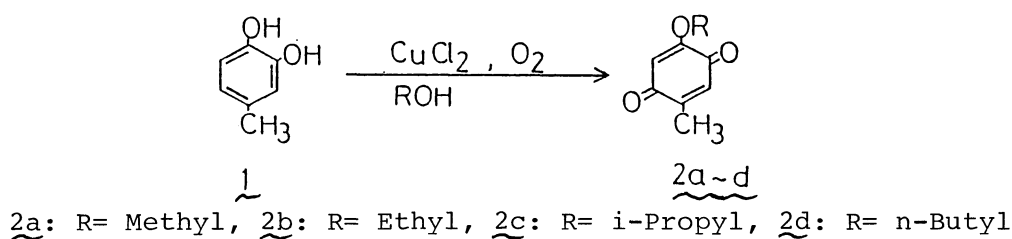


Table 1. Oxidation of 4-methylcatechol with copper(II) chloride in alcohols under oxygen

Run	Solvent	Product	Mp/ °C	Yield/% ^{a)}
1	MeOH	<u>2a</u>	170-171 ^{b)}	81
2	EtOH	<u>2b</u>	96-97 ^{c)}	75
3	i-PrOH	<u>2c</u>	111-113	61
4	n-BuOH	<u>2d</u>	101-102	65
5	t-BuOH	-	-	recovd. ^{d)}

a) Isolated Yield. b) Ref. 5, mp 170-171 °C.

c) Ref. 5, mp 96-97 °C. d) Starting material was recovered.

ed by oxygen with cupric ion again. In this reaction, copper(II) chloride spontaneously catalyzed the exchange of phenolic hydroxyl group with alkoxy group and the oxidation of phenol into quinones. It is noted that the oxidation of catechol in alcohol demonstrates the useful synthesis of alkoxy 1,4-benzoquinone and also the biomimetic phenol oxidation. This oxidation reaction could not proceed using other transition metals such as iron(III) chloride and Co(III) acetate. Detailed studies on the mechanism and application of this reaction are now in progress.

References

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- 6) ¹H NMR(CDCl₃) δ 2.25(s, 3H), 3.80(s, 3H), 5.45(b, 1H), 6.58-6.90(m, 3H).
- 7) 2a; IR(KBr) was identical with authentic IRDC card NO. 10425; ¹H NMR δ (CDCl₃) 2.06(d, J=1.5 Hz, 3H), 3.80(s, 3H), 5.90(s, 1H), 6.55(q, J=1.5 Hz, 1H)

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