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SYNTHESES OF 1,3-CYCLOPENTANEDIONES VIA INTRAMOLECULAR OXIDATIVE COUPLING OF 3,3-DISUBSTITUTED 2,4-PENTANEDIONES BY MEANS OF $Cu(OTf)_2$

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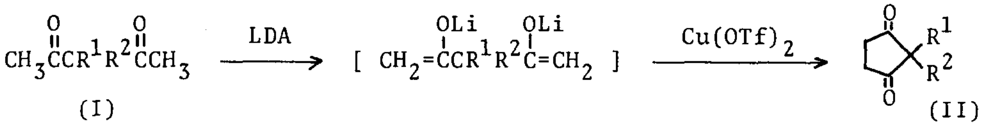
Many studies have recently been directed to the construction of five-membered ring related to syntheses of natural products with cyclopentenones$^{1)}$ and spiro[4.5]decane rings$^{2)}$. Among these five-membered rings, 1,3-cyclopentanedione derivatives are versatile precursors of fused ring systems and also those of various functionalized five-membered rings. Though 1,3-cyclopentanedione derivatives are potentially useful synthetic intermediates, alkylation at C-2 position of 1,3-cyclopentanedione with alkyl halides causes unsatisfactory results due to the competitive O-alkylation.

In this paper we wish to report a simple method for the preparation of 2,2-dialkyl-1,3-cyclopentanedione and functionalized spiro[4.n] ring systems through intramolecular oxidative coupling of dilithium enolates of 3,3-dialkyl 2,4-pentanedione by means of $Cu(OTf)_2$$^{5)}$.



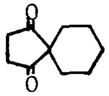
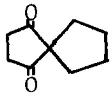
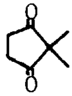
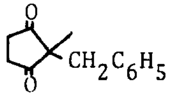
Treatment of 3,3-dialkyl-2,4-pentanedione (I) with 2.2 eq. lithium diisopropyl amide (LDA) in THF at -78° for 15 min and subsequent addition of 2.2 mol eq. $Cu(OTf)_2$ in i-PrCN afforded the corresponding coupling product (II) in 21-28% yield (Method A).

Though the yields of II are not very good, the procedure is simple "one-pot" reaction and the starting materials are readily available.

Furthermore, the reverse addition of the THF solution of dienolate formed in a similar manner mentioned above to $Cu(OTf)_2$ in THF and i-PrCN at -78° resulted in a slight increase of the yield (Method B)$^{6)}$. Results are summarized in Table.

A typical procedure (Method B) is as follows; to a THF solution (3 ml) of LDA (2.2 mmol) was added 1,1-diacetylcyclohexane (1.1 mmol) at -78° followed

Table Yield of 2,2-Dialkyl-1,3-cyclopentanedione

				Yield (%)	
(I)	R^1	R^2	(II)	Method B	Method A
	$(CH_2)_5$			47	25
	$(CH_2)_4$			27	–
	CH_3	CH_3		32	28
	CH_3	$CH_2C_6H_5$		38	21

by stirring for 10 min at the same temperature and the additional stirring for 5 min after removal of cooling bath. The resulting THF solution of the dilithium enolate was added to $Cu(OTf)_2$ (2 mmol) in THF (10 ml) and i-PrCN (2 ml) at -78° and the reaction mixture was stirred for 30 min at -78°. After the usual work-up and the following purification by column chromatography (SiO_2), the desired coupling product was obtained in 47% yield.

In conclusion, the present method for the preparation of 1,3-cyclopentane diones through $Cu(OTf)_2$ promoted oxidative coupling of 2,4-pentanediones has characteristic features, namely, its readily available starting material and the simple procedure.

References

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