

ZIRCONYL CHLORIDE CATALYSED SYNTHESIS OF 2,2'-ARYLMETHYLENE BIS(3-HYDROXY-5,5-DIMETHYL-2-CYCLOHEXENE-1-ONES) UNDER GREEN CHEMISTRY CONDITIONS.

Sharda Goel*, Vijender Goel and Anju

Department of Chemistry

Maharshi Dayanand University, Rohtak, Haryana

Introduction

Nowadays main emphasis is being laid on the adoption of cleaner, safer and environmentally benign reaction conditions avoiding the use of flammable, volatile and toxic solvents for carrying out various chemical transformations¹. C-C bond formation via condensation of active methylene containing compounds with aromatic aldehydes is a reaction of great significance in organic synthesis. In this context the choice of aqueous medium for carrying out organic reactions consumes great significance as water plays important role in biological processes as well as a medium in organic reactions which proves to be more advantageous than those in organic solvent. Therefore, switching from organic media to aqueous media as a reaction medium is a challenging and attractive task for synthetic organic chemists²⁻³.

Tetraketones are important structural precursors for synthesis of many natural products and organic compounds such as acridinediones, xanthenedione and thioxanthenes derivatives which are reported to show antioxidant properties, lipoxygenase inhibition activity and also act as potential remedial source for inflammation and asthma⁴.

Many of the reported methods for the formation of tetraketones have employed various catalysts such as In(OTf)₃, Yb(OTf)₃-SiO₂, L-hystidine in ionic liquid, proline⁵ etc. Many of these involve traditional thermal heating or microwave irradiation but they suffer from many limitations. To overcome these disadvantages, we report herein a very simple, economic and green method for synthesis of arylmethylene[bis(5,5-dimethyl-3-hydroxy-2-cyclohexene-1-ones)] tetraketones in an aqueous medium at room temperature using Zirconyl chloride as catalyst. After various attempts, we found that these reactions could proceed efficiently at room temperature for specific time period to afford essentially pure products.

Materials and Methods

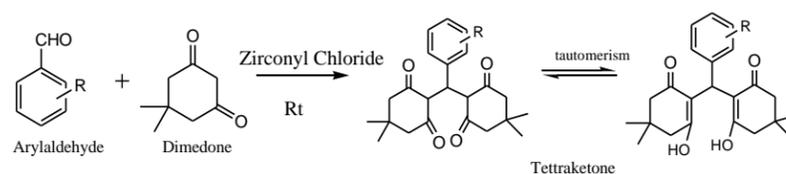
Melting points were measured on a electrothermal melting point apparatus and are uncorrected. IR spectra (KBr disc) were recorded on a Perkin Elmer FT-IR-spectrophotometer. ¹H-NMR spectra were recorded on a Bruker Avance-400 MHz spectrometer in CDCl₃ as solvent and with TMS as internal standard. Chemicals were purchased from CDH and Fluka. Confirmation of product was done by comparing with authentic samples.

General procedure for synthesis of 2, 2'-(arylmethylene)bis(3-hydroxy-5,5-dimethyl-2-cyclohexene-1-one) : Mixture of 5,5-Dimethylcyclohexane-1,3-dione (2mmol), p-chlorobenzaldehyde (1 mmol) and Zirconyl chloride (250 mg) in water (3 ml) was taken in a 10 mL Borosil beaker and stirred on a magnetic stirrer for 55 minutes. The reaction was monitored with the help of TLC. The white color product was isolated by filtration, washed with water and dried. The product was pure enough and recrystallised with pure ethanol and obtained in 88 % yield.

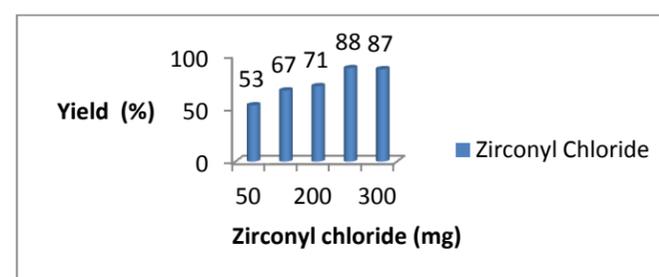
Results and Discussion

In course of development of green methodologies for synthesis of heterocyclic compounds having biological activity, herein we attempted for an efficient and high yielding synthesis of various substituted tetraketones i.e 2,2'-aryl-methylene bis(3-hydroxy-5,5-dimethyl-2-cyclohexene-1-one) from an arylaldehyde and dimedone in 1:2 ratio in aqueous medium in the presence of zirconyl chloride. In the present investigation the use of any toxic and hazardous chemicals during any stage of reaction has been avoided and it meets our requirements of reaction conditions, reaction times and yields.

2,2'-arylmethylene bis(3-hydroxy-5,5-dimethyl-2 cyclohexene-1-ones) were synthesized from a combination of different arylaldehydes and Dimedone in 1:2 ratio under aqueous reaction conditions (**scheme 1**).



The reactions were completed within 40–75 minutes at room temperature and the products were obtained via filtration and recrystallisation by ethanol. Parameters such as the quantity of catalyst, i.e. Zirconyl chloride and various temperatures were investigated. The optimized conditions were then used for the conversion of various aromatic aldehydes (**1a-1h**) to the corresponding 2,2'-arylmethylene bis(3-hydroxy-5,5-dimethyl-2 cyclohexene-1-ones) derivatives.



The results show that the presence of electron-withdrawing and electron-donating substituents on the aromatic ring of the aldehyde has no significant influence on the rate of reaction and yield. Here various aromatic aldehydes containing electron-donating and electron attracting groups, viz., 4-chlorobenzaldehyde (**1a**), 2,4-dichlorobenzaldehyde (**1b**), 4-methylbenzaldehyde (**1c**), 4-methoxybenzaldehyde (**1d**), 3,4-dimethoxybenzaldehyde (**1e**), 4-nitrobenzaldehyde (**1f**), 3-nitrobenzaldehyde (**1g**) and 4-bromobenzaldehyde (**1h**) are used which gave corresponding 2,2'-arylmethylene bis(3-hydroxy-5,5-dimethyl-2 cyclohexene-1-ones) as products in good yields.

Conclusions

We have successfully developed an simple, efficient, straightforward and economical method for synthesis of tetraketones from the reactions of arylaldehydes and Dimedone catalysed by Zirconyl chloride. This method offers advantages such as mild, aqueous experimentation conditions, economic catalyst, high yields of products and absence of any volatile organic solvent.

Acknowledgment

The authors are thankful to Head, Department of Chemistry, M. D. University, Rohtak for providing necessary facilities.

References

- [1] K. Tanaka, F. Toda, *Chem. Rev.* **2000**, 100, 1025.
- [2] P. A. Grieco, *Organic Synthesis in Water*, Thomson Science, London, **1998**, 1.
- [3] C. J. Li, *Chem. Rev.* **2005**, 105, 3095.
- [4] T. Josephrajan & V. T. Ramakrishnan, *Can. J. Chem*, **2007**, 85, 572.
- [5] D. B. Ramachary, M. Kishor, *J. org. Chem*, **2007**, 72, 5056.

*Corresponding author: Email: sgoel18989@gmail.com