



## Research Article

# A catalytic and green method for one-pot synthesis of new Hantzsch 1,4-dihydropyridines

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## Abstract

A one-step procedure has been developed for the synthesis of new Hantzsch 1,4-dihydropyridines (1,4-DHPs) with high yields from four-component reaction of 4-hydroxybenzaldehyde, acetylacetone, various primary amine and barbituric acid in EtOH in the presence of 3-methyl-1-sulfonic acid imidazolium chloride {[Msim]Cl} as an acidic ionic liquid. In this work {[Msim]Cl} acts as a more efficient and green catalyst in the multicomponent reaction, leading to a simple procedure of synthesis, short reaction times, less pollution, high yields of the products, low cost of chemicals and uses less toxic solvents.

**Keywords** Multi-component reaction · One-pot · Green chemistry · 3-Methyl-1-sulfonic acid imidazolium chloride · 1,4-Dihydropyridines

## 1 Introduction

1,4-Dihydropyridines (1,4-DHPs) are one of *N*-heterocyclic, biologically active compounds and naturally occurring molecules [1, 2]. 1,4-DHPs are also considered as key starting materials to synthesize various classes of biologically and pharmacologically active compounds [3, 4]. They are used as calcium channel blockers [5], anti-inflammatory [6, 7], antiviral [8], antitumor [9], anticancer [10], analgesic activities [11]. In additions, 1,4-DHP derivatives are employed as hepatoprotective and antidiabetic agents for the treatment of cardiovascular diseases such as hypertension [12–14].

Some methods for the synthesis of 1,4-DHP derivatives have been reported in the literature. Nevertheless, these methods generally call for harsh reaction conditions, high temperature, using of expensive reagents, create wastes,

long reaction time, needing strongly acidic condition, using multi-steps, need a complex synthetic route and no agreement with the green chemistry strategies [15]. Therefore, facile and highly efficient synthetic methods to 1,4-DHP derivatives are highly desirable [16].

One method to address this challenge includes employing multicomponent reactions (MCRs). MCRs strategy offer a significant importance over linear-strategy synthesis due to their flexible, convergent, atomic efficient nature and provide a maximum structural complexity with a minimum number of synthetic steps [17]. Reportedly, in MCRs a wide range of catalysts has been explored in the synthesis of 1,4-DHP derivatives including *L*-proline [18, 19], aspartic acid [20], *p*-toluenesulfonic acid monohydrate [21–23], TiO<sub>2</sub> nano wires [24], phosphotungstic acid (H<sub>3</sub>PW<sub>12</sub>O<sub>40</sub>) [25], silica-coated nano-Fe<sub>3</sub>O<sub>4</sub> [26], cellulose sulfuric acid [27], chitosan supported copper(II)sulfate (CSCS) [28],

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