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CONTENTS

Green Approach for the Synthesis of Chalcone: Review of Methods

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ABSTRACT

A method for synthesizing chalcones that is simple, fast, efficient, and environmentally friendly has been developed. Using green methods reduces or eliminates the risk of chemicals entering the environment and causing harm to human health, which is an absolute necessity. In this review, we discuss the various methods for synthesizing chalcone, such as microwave-assisted, ultrasound-assisted, green solar power, grinding, and more, to make products more environmentally friendly.

KEYWORDS: environment, microwave-assisted, ultrasound-assisted, green solar power, grinding.

INTRODUCTION

Chalcone is one-of-a-kind α, β-unsaturated carbonyl with biologically active properties, and it is a precursor of various heterocyclic compounds found in plants, like flavonoids. Chalcones are thought to play a fundamental role in the synthesis of various therapeutic compounds. Chalcones have piqued the interest of scientists around the world for decades due to their wide and varied pharmaceutical properties and easy preparation[1]. Different synthetic methods for the preparation of chalcone are nowadays being reported due to their remarkable biological applications. Claisen-Schmidt condensation is the most familiar reaction in the synthesis of chalcones through condensation reactions using acid or base catalysis. Due to its simplicity and better yields when compared to other conventional methods, it is the most frequently used procedure for the synthesis of chalcones[2]. The main disadvantages of this technique are the slow reaction rates and the possibility of by-products; it normally requires more reaction time and in some cases, unused starting materials[3]. The development of processes for the sustainable production of chemicals and materials is referred to as the "green synthetic protocol"[4]. Energy-efficient and environmentally sustainable processes such as microwave-assisted, ultrasound-assisted, green solar-assisted, and grinding are used in the synthesis of different biologically active compounds. The green approach to chalcone synthesis is described below.

Green synthetic approaches: Green chemistry approaches for carrying out various chemical reactions include microwave irradiation (MWI), ultrasonication, green solar-assisted and grinding. By using these technologies organic reactions become more efficient and cost-effective by increasing the rate of the reaction with reduced reaction time and high product yield and reducing the chances of by-products[5].

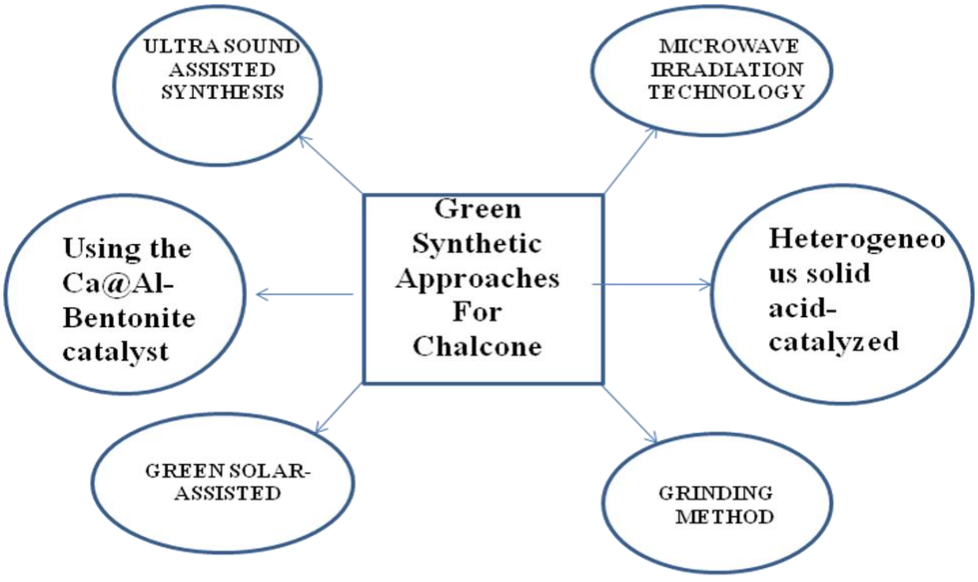
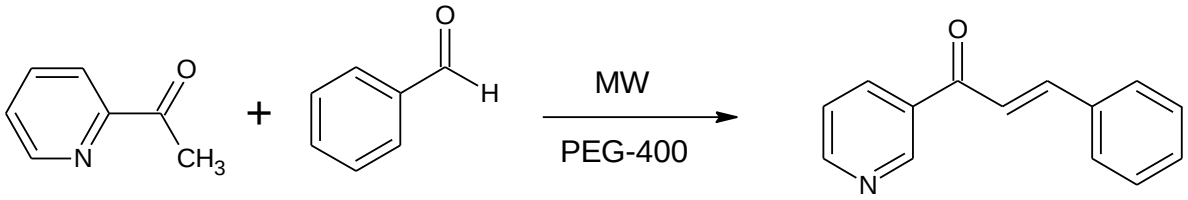
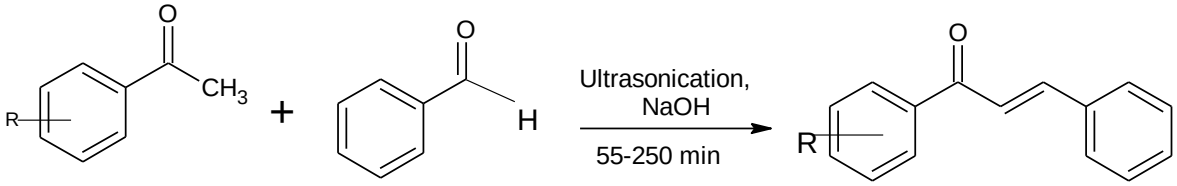


Fig.1 Green Synthetic Approaches For Chalcone

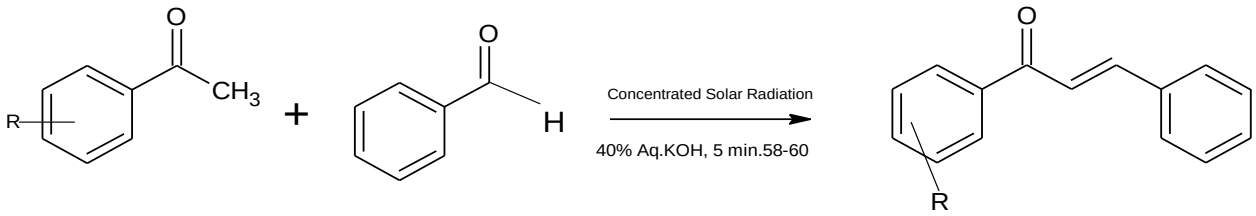
Microwave Irradiation Technology: In recent years, microwave irradiation has increased in popularity in the field of organic synthesis due to enhanced yield, purity, faster reaction time, conserving energy, heating which is uniform and selective, lower energy consumption, enhance reaction reproducibility, support the creation of more easy and cleaner synthetic routes[6]. A mixture of Heterocyclic ketone and aromatic aldehyde was thoroughly mixed in 20 ml of PEG-400 and then Aq.40% KOH. Microwave irradiation was applied to the reaction mixture for 2-3 minutes [7].



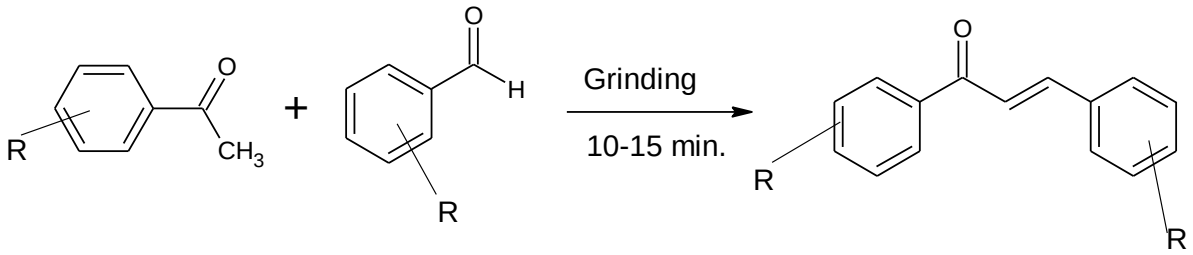
Ultrasound-assisted: Ultrasound, through the process of acoustic cavitation, accelerates the reactivity of molecules to many chemical reactions. The use of US irradiation effectively greatly reduces reaction times[8].Using the Sonochemical method a mixture of aromatic aldehydes in 10-20 mL absolute ethanol and substituted aromatic ketone with aqueous sodium hydroxide under ultrasound irradiation for 55-250 min[9].



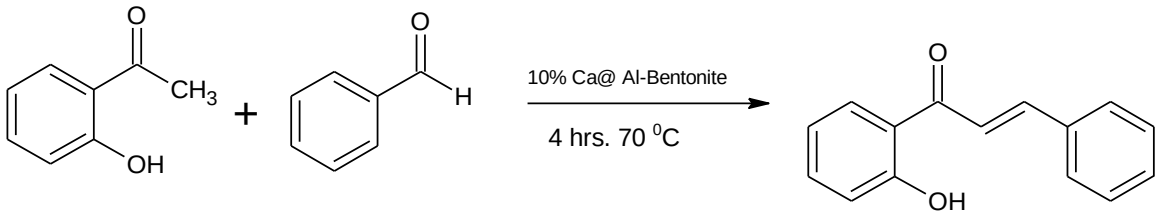
Green solar-assisted: Solar energy is a renewable source of energy that is free to use. Solar radiation emits a wide range of ultraviolet and infrared radiation with wavelengths ranging from 280 to 4000 nm, which can be used to generate both photochemical and thermal energy. In this regard, solar energy is a competent tool for the reaction and offers some advantages.In a round-bottom flask, a solution of substituted aromatic ketone in ethanol was prepared. A 40% aqueous solution of potassium hydroxide was added dropwise to a solution of 4-methoxyacetophenone while being constantly stirred with a magnetic stirrer. The R.B. flask was placed at the Fresnel lens's focal point. After waiting 5 minutes for the reaction mass temperature to reach 58–60 ^{0}C, a drop-by-drop addition of an aromatic aldehyde solution in ethanol with constant stirring was completed[10].



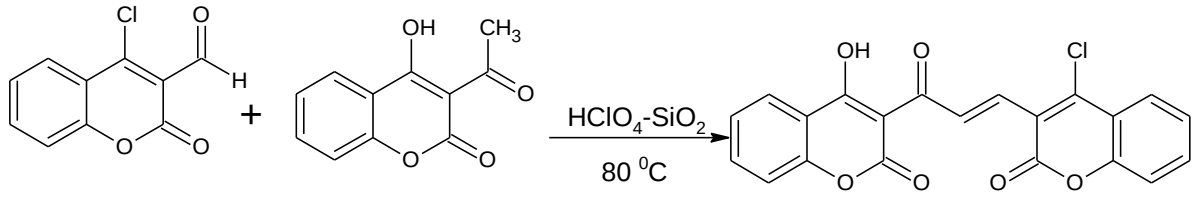
Grinding: The grinding technique is also a green synthetic method for conducting chemical reactions with a high product yield under solvent-free conditions. The grindstone technique generates local heat by grinding crystals of substrate and reagent with a mortar and pestle. Grinding activates reactions by transferring a small amount of energy through friction. In a mortar, a substituted aromatic ketone, various substituted aldehydes, and a solid pallet of KOH were ground for several minutes[11].



Using the Ca@Al-Bentonite catalyst: Green Chemistry principles are recognized in the field of organic transformation which is carried out in mild conditions by using heterogeneous catalysts which are safer for the environment and have unique properties. A mixture of 2-hydroxyacetophenone and benzaldehyde in ethanol and 10% Ca@Al-Bentonite was refluxed at 70 ^{0}C for 4 hours[12].



Heterogeneous solid acid-catalyzed reactions: The goal of developing a green and clean synthesis method can be accomplished by avoiding the use of solvents and robust solid catalysts. For the solvent less synthesis of coumarinyl chalcones, a solid acid catalyst of $HClO_4$-SiO_2 was used. The reported method was used to establish the silica-supported perchloric acid catalyst. At 80°C, condensation of 4-chloro-3-formyl coumarin with 3-acetyl-4-hydroxy coumarin was carried out at 80°C using an $HClO_4$ -SiO2 catalyst, obtaining a yield of 92% within 10 min[13].



CONCLUSION

These techniques are effective in Chalcone synthesis. Their development has been expedited in recent years in an effort to gain insight into the process of action inside the reaction flask. The desired product is obtained quantitatively without any undesirable byproducts and in a short reaction time.

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