

# Ultrasound Assisted Copper (I) Catalyzed Conjugate Addition of Heterocyclic bromides to 1, 1-Diacetate

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## ABSTRACT

1,1-Diacetate was prepared from cinnamaldehyde and acetic anhydride by reported method. The conjugated addition products were synthesized from heterocyclic bromides and 1,1-diacetate in the presence of 10 mol % Cu (I) catalyst in high yields within 15-25 min. under ultrasound irradiation.

**Keywords:** Conjugate addition, Diacetate, Cu (I) catalyst, Heterocyclic bromides, Ultrasound irradiation.

## I. INTRODUCTION

The protection of aldehydes by the formation of 1,1-diacetate is very important in synthetic organic chemistry because of the easy conversion of products into the parent aldehydes.<sup>1-4</sup> The 1,1-diacetates were synthesized from aldehydes and acetic anhydride using different catalyst such as sulfuric acid,<sup>5</sup> Nafion-H,<sup>6</sup> zinc chloride,<sup>7</sup> and phosphorus trichloride.<sup>8</sup> The sonochemical addition of alkyl halides to  $\alpha$ ,  $\beta$ -unsaturated carbonyl compounds and nitriles in the presence of a zinc-copper couple in aqueous medium has been developed.<sup>9</sup> Organozinc reagents are very important in organometallic chemistry for easy formation of products and transmetalation.<sup>10-13</sup> The organozinc halides undergo transmetalation by transition metal salt or complex such as copper, palladium, nickel, cadmium etc.<sup>13-17</sup> The coupling reactions such as Suzuki, Still, Grignard and Negishi are catalyzed by transition metal.<sup>17-24</sup> The coupling of aryl bromide to acyl chloride and opening of epoxide have been developed for the formation of new carbon-carbon bond.<sup>25-26</sup> The formation of new carbon-carbon bond between aryl bromides and  $\alpha$ ,  $\beta$ -unsaturated carbonyl compounds is very difficult. But

we have developed one method for the formation of carbon-carbon bond by insertion of zinc metal in aryl bromide. In present work, we have synthesized different conjugated addition product using heterocyclic bromides and 1,1-diacetate in the presence of Cu (I) catalyst ( $\text{Cu}(\text{MeCN})_4\text{BF}_4$ ) at room temperature within 15-25 min. under ultrasound irradiation.

## II. METHODS AND MATERIALS

The starting materials were purified before reactions. The sonochemical experiments were carried out in an ultrasonic cleaner with frequency of 33 KHz and a normal power of 250 W. The IR spectra were recorded on a Shimadzu Miracle 10 ATR. The products were analyzed by <sup>1</sup>H NMR. <sup>1</sup>H NMR spectra were recorded on a Bruker 500 MHz with  $\text{CDCl}_3$  as the solvent with TMS as an internal standard. The reaction progress was monitored by TLC using pet. ether/hexane as the mobile phase. The spots were visualized using UV cabinet. Crude products were purified by column chromatography using pet. ether/ethyl acetate as a solvent.

### Procedure for preparation of Reike Zinc metal:-

In a 100 ml two neck RBF was flushed by nitrogen. A mixture of 0.05 gm lithium metal. 0.1 gm naphthalene and 5 ml THF was stirred at room temperature to observed dark green colour solution, then 5 ml saturated solution of ZnCl<sub>2</sub> in THF was added to above dark green colour solution by syringe and mixture was sonicated for 30 min. the black grey colour zinc metal observed in RBF.

### Typical procedure for preparation of Aryl zinc bromide and conjugate addition to 1,1-diacetate:-

5 ml saturated solution of LiCl in THF and 5 mmol aryl bromide in 2 ml THF was added in zinc metal solution, then sonicated for 30 min, the formation of organozinc takes place, it was confirmed by TLC. Finally, 5 mmol 1,1-diacetate in 2 ml THF & 10 mol % Cu (I) catalyst were added in reaction mixture. The reaction mixture was sonicated for 15-25 min. at room temperature. After completion of reaction, saturated NH<sub>4</sub>Cl solution was added (2x5 ml), washed with brine solution (10 ml) and dried over Na<sub>2</sub>SO<sub>4</sub>. The extract was then concentrated and the crude product was purified using column chromatography ( silica gel 20% EtOAc/80% pet ether ) to afford pure compound. Products are easily identified by comparison of their spectroscopic data.

### Spectral data of Products:

**5a:** IR (  $\nu$  cm<sup>-1</sup>) 2958 (Aromatic C-H), 1761 (-COO), 1668 (C=N), 1500-1650(C=C), <sup>1</sup>HNMR (500 MHz, CDCl<sub>3</sub>)  $\delta$  2.1 (s, CH<sub>3</sub> 3H), 4.1(d, 5Hz, 1H), 6.5(d,  $J=7$  Hz, 1H), 6.9(d,  $J=7$  Hz, 1H) 7.2-8.3 (m, 9 H, ArH) ppm.

**5b:** IR (  $\nu$  cm<sup>-1</sup>) 2954 (Aromatic C-H), 1762 (-COO), 1500-1650 ( C=C), <sup>1</sup>HNMR (500 MHz, CDCl<sub>3</sub>)  $\delta$  2.1 (s, CH<sub>3</sub> 3H), 4.2(d, 5Hz, 1H), 6.5(d,  $J=7$  Hz, 1H), 6.9(d,  $J=7$  Hz, 1H) 7.2-8.3 (m, 8H, ArH) ppm.

**5c:** IR (  $\nu$  cm<sup>-1</sup>) 2980 (Aromatic C-H), 1759 (-COO), 1500-1650 ( C=C), 3320 (-NH) <sup>1</sup>HNMR (500 MHz, CDCl<sub>3</sub>)  $\delta$  2.1 (s, CH<sub>3</sub> 3H), 4.1(d, 5Hz, 1H), 6.5(d,  $J=7$

Hz 1H), 6.8(d,  $J=7$  Hz, 1H) 7.2-8.5 (m, 10H, ArH) ppm.

**5d:** IR (  $\nu$  cm<sup>-1</sup>) 2984 (Aromatic C-H), 1762 (-COO), 1671 (C=N), 1500-1650 ( C=C), <sup>1</sup>HNMR (500 MHz, CDCl<sub>3</sub>)  $\delta$  2.1 (s, CH<sub>3</sub> 3H), 4.2(d, 5Hz, 1H), 6.4(d,  $J=7$  Hz 1H), 6.7(d,  $J=7$  Hz, 1H) 7.2-8.4 (m, 8H, ArH) ppm.

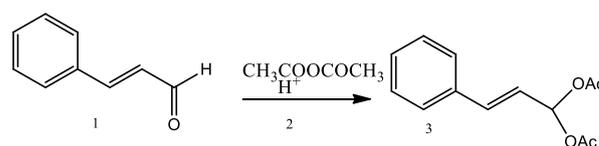
**5e:** IR (  $\nu$  cm<sup>-1</sup>) 2978 (Aromatic C-H), 1755 (-COO), 1673 (C=N), 1500-1650 ( C=C), <sup>1</sup>HNMR (500 MHz, CDCl<sub>3</sub>)  $\delta$  2.1 (s, CH<sub>3</sub> 3H), 4.2(d, 5Hz, 1H), 6.6(d,  $J=7$  Hz 1H), 6.9(d,  $J=7$  Hz, 1H) 7.2-8.5 (m, 7H, ArH) ppm.

**5f:** IR (  $\nu$  cm<sup>-1</sup>) 2988 (Aromatic C-H), 1758 (-COO), 1667 (C=N), 1500-1650 ( C=C), <sup>1</sup>HNMR (500 MHz, CDCl<sub>3</sub>)  $\delta$  2.1 (s, CH<sub>3</sub> 3H), 4.1(d, 5Hz, 1H), 6.4(d,  $J=7$  Hz 1H), 6.9(d,  $J=7$  Hz, 1H) 7.2-8.6 (m, 7H, ArH) ppm.

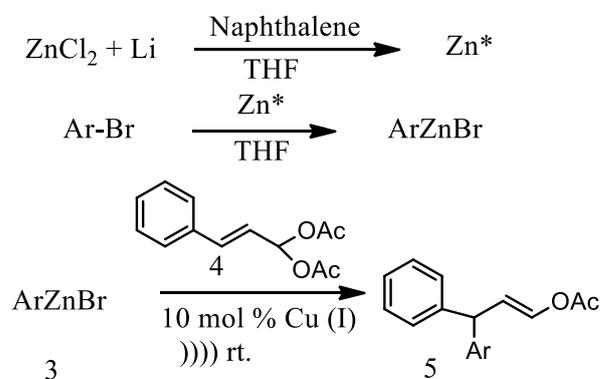
**5g:** IR (  $\nu$  cm<sup>-1</sup>) 2987 (Aromatic C-H), 1763 (-COO), 1668 (C=N), 1500-1650 ( C=C), <sup>1</sup>HNMR (500 MHz, CDCl<sub>3</sub>)  $\delta$  2.17 (s, CH<sub>3</sub> 3H), 4.1(d, 5Hz, 1H), 6.5(d,  $J=7$  Hz 1H), 6.9(d,  $J=7$  Hz, 1H) 7.2-8.4 (m, 6H, ArH) ppm.

**5h:** IR (  $\nu$  cm<sup>-1</sup>) 2978 (Aromatic C-H), 1760 (-COO), 1678 (C=N), 1500-1650 ( C=C), <sup>1</sup>HNMR (500 MHz, CDCl<sub>3</sub>)  $\delta$  2.1 (s, CH<sub>3</sub> 3H), 4.1(d, 5Hz, 1H), 6.5(d,  $J=7$  Hz 1H), 6.9(d,  $J=7$  Hz, 1H) 7.2-8.3 (m, 11H, ArH) ppm.

## III. RESULTS AND DISCUSSION

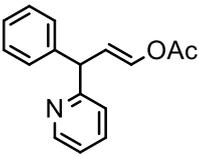
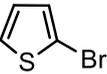
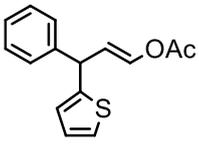
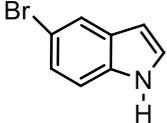
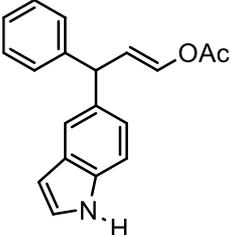
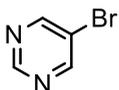
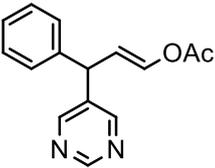
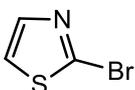
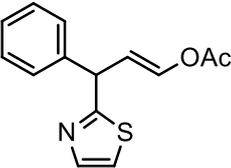
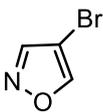
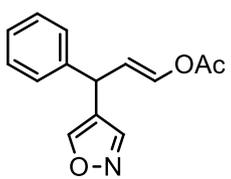
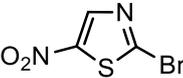
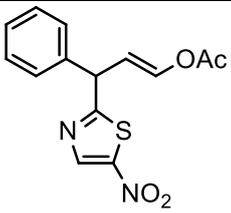
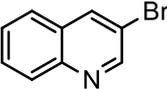
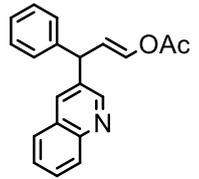


**Scheme 1.** Synthesis of 1,1-diacetate



**Scheme 2.** Conjugate addition of Ar group.

**Table 1.** Copper (I) catalyzed Conjugate addition of aryl zinc bromide to 1,1-diacetate under ultrasound irradiation.

Entry	Ar-Br	Product	Time, min.	Yield %
5a			17	85
5b			20	82
5c			22	78
5d			16	89
5e			21	85
5f			24	91
5g			20	85
5h			18	86

From the table 1 We have observed that Cu(MeCN)<sub>4</sub>BF<sub>4</sub> found to be best catalyst for the conjugated addition reactions and excellent yields were obtained.

#### IV. CONCLUSION

A simple, rapid and inexpensive procedure has been developed for conjugative addition of heterocyclic bromides to 1,1-diacetate under ultrasound irradiation which can be a useful alternative to existing methods. The products were isolated in good to excellent yields after 15-25 min. sonication at room temperature. The results of sonochemical experiments were just slightly better than that in the classical reactions.

#### V. ACKNOWLEDGMENTS

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