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**Sachin Choudhary**

## Abstract

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The present thesis is mainly covering the synthesis of five-, and six-membered nitrogen heterocycles such as functionalized pyrroles and oxazepine-fused pyrroles/1,2-dihydropyridines (DHPs) under metal-free conditions. This thesis is divided into six chapters:

**The First Chapter** gave a brief discussion on organocatalysis, in particular, amine catalysis and its applications for the development of various transformations such as direct Mannich reaction to achieve the synthesis of natural and non-natural compounds with varying selectivity. In addition, the utilization of linear dialdehydes such as succinaldehyde and glutaraldehyde for amine-catalyzed transformations to access various carbo-, and hetero-cyclic compounds have been discussed.

**The Second Chapter** demonstrates the synthesis of substituted pyrrole-3-methanols under microwave conditions. This one-pot protocol involves proline-catalyzed direct Mannich reaction-cyclization and dehydrocyanation between succinaldehyde and  $\alpha$ -iminonitriles followed by  $\text{NaBH}_4$  reduction sequence in good yields.

**The Third Chapter** demonstrates the regioselective synthesis of 4-iodo and 5-iodo-pyrrolecarbaldehyde from the common starting material by switching the reacting conditions. The synthesis of 4-iodo-pyrrole-3-carboxaldehydes proceed through proline catalyzed direct Mannich reaction-cyclization sequence between in situ generated imines and succinaldehyde, followed by selective iodination and aromatization using molecular  $\text{I}_2$ , whereas, 5-iodo-pyrrole-3-carboxaldehydes was prepared in two-step process.

**The Fourth Chapter** demonstrates the synthesis of tetracyclic dibenzoxazepine-fused pyrroles in high to excellent yields. These polycyclic pyrroles were obtained through proline-catalyzed direct Mannich/cyclization sequence between succinaldehyde and seven-membered dibenzoxazepine-imines, followed by IBX-mediated oxidative aromatization in the same pot.

**The Fifth Chapter** demonstrates amine-catalyzed asymmetric one-pot synthesis of dibenzoxazepine fused-1,2-dihydropyridines (DHPs). This one-pot operation proceeds through L-proline-catalyzed direct Mannich/cyclizations sequence between dibenzoxazepine-imines and aqueous glutaraldehyde, followed by IBX-mediated site-selective dehydrogenative in the same pot with high yields and excellent enantioselectivity (>99:1 er).

**The Sixth Chapter** is a compilation of the overall thesis work and the future scope of the present research work is also presented.

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## LIST OF ABBREVIATIONS / SYMBOLS

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| Abbreviation/Symbol | Description                          |
|---------------------|--------------------------------------|
| $\alpha$            | Alpha                                |
| $[\alpha]$          | specific rotation                    |
| $\beta$             | Beta                                 |
| $\gamma$            | Gamma                                |
| $\delta$            | Chemical shift                       |
| $\Delta$            | Heat                                 |
| Å                   | Angstrom                             |
| Ac                  | Acetyl                               |
| Aq                  | Aqueous                              |
| ACN                 | Acetonitrile                         |
| Ar                  | Aryl                                 |
| Bu                  | Butyl                                |
| <i>t</i> -BuOK      | Potassium <i>tert</i> -butoxide      |
| Calcd.              | Calculated                           |
| °C                  | Degree centigrade                    |
| <sup>13</sup> CNMR  | Carbon-13 nuclear magnetic resonance |
| Cat.                | Catalyst                             |
| CAN                 | Ceric ammonium nitrate               |
| CDCl <sub>3</sub>   | Deuterated chloroform                |
| Conc                | Concentration                        |
| COSY                | Correlation Spectroscopy (NMR)       |
| d                   | Doublet                              |
| DBO                 | dibenzoxazepine                      |
| DABCO               | 1,4-Diazabicyclo[2.2.2]octane        |
| DBU                 | 1,8-Diazabicyclo[5.4.0]undec-7-ene   |
| dd                  | Doublet of doublet                   |
| DDQ                 | 2,3-Dichloro-5,6-Dicyanobenzoquinone |
| DMSO                | Dimethylsulphoxide                   |
| DMSO-d <sub>6</sub> | Deuterated Dimethylsulphoxide        |

## LIST OF ABBREVIATIONS / SYMBOLS

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|                   |  |
|-------------------|--|
| DCE               | Dichloroethane                           |
| DCM               | Dichloromethane                          |
| DMA               | <i>N,N</i> -Dimethylacetamide            |
| DMAD              | Dimethyl acetylene dicarboxylate         |
| DMF               | <i>N,N</i> -Dimethylformamide            |
| ESI               | Electron Spray Ionization (MS)           |
| EtOAc             | Ethyl acetate                            |
| Equiv             | Equivalent                               |
| E                 | Electrophile                             |
| g                 | Gram                                     |
| HRMS              | High Resolution Mass Spectra             |
| HSQC              | Heteronuclear Single Quantum Correlation |
| IBX               | 2-Iodoxybenzoic acid                     |
| IR                | Infrared                                 |
| Hz                | Hertz                                    |
| hr                | Hour                                     |
| <i>J</i>          | Coupling constant                        |
| Lit.              | Literature                               |
| MS                | Mass spectrometry                        |
| M.P               | Melting point                            |
| m                 | Multiplet                                |
| mg                | Milligram                                |
| MHz               | Mega hertz                               |
| min               | Minutes                                  |
| mL                | Milliliter                               |
| mmol              | Millimole                                |
| MW                | Microwave                                |
| N <sub>2</sub>    | Nitrogen gas                             |
| Nu                | Nucleophile                              |
| <sup>1</sup> HNMR | Proton Nuclear Magnetic Resonance        |

## LIST OF ABBREVIATIONS / SYMBOLS

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|   |  |
|---|--|
| NOE   | Nuclear Overhauser Effect (NMR)              |
| NOESY   | Nuclear Overhauser Effect Spectroscopy (NMR) |
| O <sub>2</sub>                                | Oxygen gas                                   |
| PEG   | Polyethylene glycol                          |
| ppm   | Parts per million                            |
| %   | Percentage                                   |
| <i>p</i> -TsOH                                | <i>p</i> -Toluenesulfonic acid               |
| PMP   | <i>p</i> -methoxyphenyl                      |
| rt  | Room temperature                             |
| s   | Singlet                                      |
| NBS   | <i>N</i> -bromosuccinimide                   |
| NIS   | <i>N</i> -iodosuccinimide                    |
| NaHCO <sub>3</sub>                            | Sodium hydrogencarbonate                     |
| Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> | Sodium thiosulfate                           |
| t   | Triplet                                      |
| TBAB  | Tetrabutylammonium bromide                   |
| Ts  | Tosyl  |
| <i>Tert</i> -                                 | Tertiary                                     |
| TFA   | Trifluoroacetic acid                         |
| THF   | Tetrahydrofuran                              |
| TLC   | Thin layer chromatography                    |
| TMS   | Tetramethylsilane                            |
| σ   | Sigma  |