## **CHAPTER 5**

## Conclusions

### 1.1 Development of Green Methodologies for Organic Halide Oxidation Using

# Amine N-oxide as Oxidants

New facile and efficient procedure for NMO oxidation of organic halides was attempted to develop using green energy source; ultrasonic and microwave irradiation. In ultrasonic reaction, the reaction was performed by using 4-fold excess of NMO and 10 mol% of KI catalyst in DMSO solvent at room temperature. This reaction proceeds very well with a range of benzylic halides to obtain corresponding aldehydes in good to excellent yield within 10-20 min. However, the use of DMSO as solvent makes this condition be suffered from work-up by the need of several steps of extraction for purification of product. This make the condition with DMSO prohibited from green methodology. Consequently, the green oxidative procedures for organic halide were then developed using ionic liquid as solvent under microwave irradiation. Microwave has provided rapid oxidation of benzylic halides to the corresponding aldehydes in good to excellent yields by using 2.0 equivalent of NMO with 10 mol% of KI catalyst. The more advantage of the developed protocol is that can be efficiently applied with any amine N-oxide such as PyNO. In addition, the association of IL in reaction avoids the use of volatile and/or toxic solvent, facilitates work-up procedure, while IL itself can be easily recovered and reused.

The use of functionalized polymer supports in synthetic organic chemistry has recently grown immensely. Solid-supported reagent offers an ability to remove excess reagents from reaction solution by filtration and rinsing of the support dramatically reduces the time allotted to purification. The selection and synthesis of new, more suitable, polymers and their applications in synthetic schemes will provide the basis for much research in the years to come. Here in, polymer supported methylpiperazine N-oxide ionic liquid (**P4**) was prepared. **P4** was synthesized by suspension polymerization of 4-vinylpyridine and DVB cross-linker to form beads of poly(4-vinylpyridine) and were then functionalized by chemical target moieties. The polymer supported **P4** was examined an efficiency as oxidant agents for the oxidation of benzyl chloride which allowed benzyl chloride be converted to benzaldehyde in 41% under sonication at room temperature for 1 h. In continuation of the work described in this study, method for test a course of reaction on solid support and accurate loading estimation of amine N-oxide on the support surface has to be investigated.

# **1.2 Development of One-pot** *In Situ* Oxidation/ Reductive Amination of Benzyl Halides under Solventless and Ultrasonic Irradiation

Ultrasound (US) has been proven as a powerful alternative energy to enhance the reaction rate, product yields, and selectivity in a number of organic transformations. Owing to these advantages, ultrasound may thus increase reaction rate in heterogeneous or partially-miscible substrates reactions make this reduce mass transfer limitations. In this study, an *in situ* oxidation/reductive amination of benzyl halides was developed under solvent-free ultrasonic irradiation as a facile, efficient, and environmental friendly method toward *N*-alkylated amines. Benzylic halides and benzyl chloride derivatives together with a range of amines can be efficiently converted into the secondary and tertiary amine products in good to excellent yields. This is demonstrating that the cooperation of an oxidizing and reducing agent under ultrasonic acceleration can be undergone one-pot oxidation/reductive amination to give clean reaction without side reaction of overoxidation and reduction of aldehydes. The reaction sequence reported is simple, rapid and eco-friendly and hopefully this developed protocol will be find application in organic synthesis.

#### 1.3 Development of Alcohol Oxidation using NMO as an Oxidizing Agent

The conversion of alcohol into corresponding aldehyde oxidation was investigated by using NMO as an oxidizing agent. Firstly, microwave-assisted procedure of this transformation was developed. The experiment carried out ionic liquid as solvent and may be also acted as halogenating for the displacement of hydroxy group to form active halide compound, followed by successively oxidized with NMO via  $S_N2$  mechanism. Unfortunately, this attempt failed to give satisfied results by giving high amount of sustained toluene, by-product, even both Brønsted and Lewis acid were presented as a catalyst. Another attempt, a procedure for one-pot conversion of alcohol into the corresponding carbonyl compound without the use of a toxic and expensive heavy metal catalyzed system was developed. The developed strategy utilized a sequential of chemical iodination and oxidation under ultrasonic irradiation. This protocol provided high product yield with no overoxidation to carboxylic acids. In addition, the iodination with polymer-supported PPh<sub>3</sub>/I<sub>2</sub> allows an easy work-up by simple filtration and compatibility with the subsequence oxidation with NMO. The reaction is simple, rapid and also exhibits an unprecedented degree of chemoselectivity for the oxidation of primary benzylic alcohol in the presence of secondary or aliphatic ones. These features should make it of significant synthetic value.



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