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REVIEW ARTICLE

Ammonium Iodide (NH_4I)-Mediated Heterocyclic Ring Formations (2020 Onwards)

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Abstract: Heterocycles consistently attract scientific interest due to their unique structures, which have led to several applications in organic chemistry, pharmacology, and materials research. In organic chemistry, a range of reactions that add one or more rings to a molecule are collectively referred to as ring-forming or ring-closing reactions. Heterocyclic ring formation (HCRF) is the process of forming cyclic structures in which other elements, such as nitrogen, oxygen, sulfur, and so on, take the place of carbon atoms. The inexpensive, commercially accessible, inorganic white ionic solid with the formula NH_4I is ammonium iodide. It serves as a redox mediator, an electrolyte, a promoter, and the best option for "N" or ''iodide'' sources (metamorphosis from inorganic to organic) in a variety of synthetic organic transformations. Its applications range from laboratory research to industrial processes. As of date, there are no exclusive reports on the applications of NH_4I in catalysis or organic synthesis. In this review (2020 onwards till date), we thoroughly and critically report the applications of this versatile reagent in heterocyclic ring formation reactions that lead to the synthesis of various heterocyclic scaffolds related to simple systems, namely thipophenes, pyridines, thiazoles, isothiazoles, pyrroles, 1,3,5-triazines, pyrazoles, 1,2,4-thiadiazoles and fused systems, namely benzimidazoles, benzothiazoles, quinolines, quinazolines, phenothazines, indolizines, benzoxazoles, fused imidazoles, β-carbolines, *etc.* In addition to the advantages, the limits of the approaches were also examined. We strongly hope that this compilation will be helpful to researchers and academicians worldwide in exploring further the applications of NH4I in various synthetic organic transformations.

Keywords: Ammonium iodide (NH_4I), heterocycles, ring formation, C-H functionalization, C-C, C-heteroatom, heteroatom-heteroatom bond formations.

1. INTRODUCTION

Ammonium iodide is an inorganic white ionic compound represented by the formula NH_4I. This salt has an ammonium cation and an iodide anion [1]. It may be synthesized by the reaction of hydroiodic acid with ammonia. It readily dissolves in water, from which it crystallizes into cubic forms. It is also soluble in ethanol [2]. Ammonium iodide in aqueous solutions is acidic and exhibits increased vapour pressure at higher temperatures. It also serves as a dietary supplement to address iodine deficiency. Cesar and colleagues examined the development, scope, limits, and mechanism of iodine(III) in combination with aluminum or ammonium salts [3]. Das *et al.* assembled NaI/KI/NH_4I and TBHP as potent oxidation systems for the synthesis of diverse chemical linkages [4]. In the past, we utilized NH_4I as an iodine source for the cyclization of 2′-hydroxychalcones into flavones [5]. This looks very promising for exploring cheap reagents such as NH_4I in various synthetic applications, *e.g.,* carbon-carbon, carbon-heteroatom, and heteroatom-heteroatom bond-forming reactions [6-7].

In medicinal chemistry, heterocyclic compounds-rings with at least one heteroatom (N, O, or S)-are significant. Synthetic chemicals, biomolecules, and natural products all frequently have these structures [8-10]. They are essential in biotechnology, materials, dyes, medicines, and agriculture due to their unique chemical properties. Heterocycles are present in approximately 75% of FDA-approved drugs, underscoring their importance in drug development due to their unique capacity to interact with biological systems and enhance pharmacokinetic properties [11-13]. The process of forming cyclic structures in which carbon atoms are replaced by elements like nitrogen, oxygen, and sulfur is known as

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