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Visible light-driven innovative approaches for the synthesis of quinoline and isoquinoline based heterocycles

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ABSTRACT

Heterocyclic compounds represent essential frameworks that are prevalent in nature and demonstrate intriguing biological and pharmaceutical properties. Quinoline and isoquinoline derived scaffolds represent a category of *N*-heterocyclic compounds that exhibit a wide array of biological properties. Reactions mediated by visible light have developed into a formidable instrument in organic synthesis over the last 15 years, transforming the methodologies employed by chemists in tackling complex bond-forming processes.

This review constitutes the most thorough examination to date of photochemical strategies for the synthesis of quinoline and isoquinoline derivatives, encompassing advancements in this domain from 2021 to the present. The organization is based on the categories of starting compounds, and it delves into synthetic strategies for the target compounds, accompanied by proposed reaction mechanisms. We anticipate that this compilation will inspire chemists to explore innovative, eco-conscious approaches for the synthesis of these and other biologically important nitrogen-rich heterocycles.

Introduction

Heterocyclic compounds have garnered significant research interest owing to their numerous vital biological and medicinal applications [1,2]. They are found in more than 90 % of newly developed medications, serving as a crucial link between the realms of chemistry and biology, where significant scientific progress and application occur [3,4]. While nitrogen, oxygen, and sulfur stand out as the most common heteroatoms, it is noteworthy that heterocyclic rings incorporating alternative heteroatoms, including phosphorus, iron, magnesium, selenium, and others, are frequently encountered as well. The diverse applications of heterocyclic compounds that incorporate nitrogen render them indispensable in the field of medicinal chemistry [5–8].

Quinoline and isoquinoline derived scaffolds represent a distinctive category of *N*-heterocyclic compounds, exhibiting a wide array of biological properties, including anti-malarial, anti-cancer, and herbicidal activities [9–18]. Quinoline and isoquinoline are structural isomers, classified as benzopyridines, which consist of a benzene ring fused to a pyridine ring. The distinction between them lies in the positioning of the nitrogen atom within the fused rings: quinoline features the nitrogen in

Abbreviations: AQ, Anthraquinone; Boc, *t*-Butyloxy carbonyl; CFL, Compact Fluorescent Lamp; DBU, 1,8-Diazabicyclo(5.4.0)undec-7-ene; EDA, Electron donor-acceptor; EDGs, Electron Donating Groups; ET, Electron Transfer; EWG, Electron Donating Group; HAT, Hydrogen Atom Transfer; HE, Hantzsch Esters; HOMO, Highest Occupied Molecular Orbital; LED, Light Emitting Diode; LUMO, Lowest Unoccupied Molecular Orbital; ND, Not Determined; NHPI, *N*-hydroxyphthalimide; NR-, No Reaction; PC, Photocatalyst; PCET, Proton-coupled electron transfer; PEG, Polyethylene glycol; PIDA, Iodobenzene diacetate; PQ, Phenanthrenequinone; RT, Room Temperature; SCE, Standard Calomel Electrode; SET, Single Electron Transfer; VLPC, Visible Light Photoredox Catalysis; TEMPO, 2,2,6,6-Tetramethyl-1-piperidinyloxy; THQ, 1,2,3,4-Tetrahydroquinolines; TMEDA, Tetramethylethylenediamine; TOF, Turnover Frequency; TON, Turnover Number; Ts, Tosyl.

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