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Commentary

Recent Approaches in Heterocyclic Ring Compounds: Benzimidazoles and their Derivatives

Lingue Pi*

Department of Chemistry, Baoji University of Arts and Science, Baoji, China

DESCRIPTION

Benzimidazoles are heterocyclic ring structures with two nitrogen atoms that have been fused. They are crucial therapeutically in drug discovery. Many clinically approved drugs have been developed from benzimidazole, and these include liarozole and pracinostat (anticancer), omeprazole (proton pump inhibitors), oxfendazole (anthelmintic), enviroxine (antiviral), ilaprazole (antiulcer), ridinilazole (antibacterial), flubendazole (antiparasitic), bilastine (antihistaminic), and many more. Because of the numerous therapeutic applications of benzimidazole and its derivatives, many researchers have developed more biologically active compounds containing benzimidazole, broadening the scope of finding a cure for other diseases; as a result, many new pharmaceutical drugs containing benzimidazole are expected to be available within the next decade.

Heterocyclic compounds are cyclic organic molecules that contain additional elements like nitrogen, oxygen, or sulphur. The positive results on the chemistry, structure-activity relationship, and biological activities of various heterocycles have piqued the interest of many medicinal chemists. They are found in both natural and manmade compounds. A nitrogen heterocycle is found in 59% of small-molecule medicines, and these chemicals are extremely important to pharmaceutical companies. Benzimidazole is a heterocyclic compound that is extensively utilised as an organic synthesis building block.

Benzimidazole is a bicyclic molecule with a benzene ring fused to a five-membered imidazole containing two nitrogen atoms. It is also known as 1H-benzimidazole, benzoglyoxaline, or 1,3-benzothiazole. The condensation reaction of 1,2-phenylenediamine with carboxaldehyde and carboxylic acids produces benzimidazoles. They have been reported to have little toxicity and to be highly effective against a wide range of pathogenic strains. As previously stated, this heterocyclic ring structure has been discovered in both naturally occurring and synthesised medicinal substances and has served as an important building block in the development of several commercialised medications.

The usage of benzimidazole as a medication derivative has contributed in overcoming some of the challenges associated with drug resistance caused by continuous use, necessitating therapies with higher efficacy and lower side effects. Many researchers were interested in the synthesis of benzimidazole and its derivatives after discovering that 5,6-dimethyl benzimidazole is a vitamin B_{12} metabolite. Simultaneously, the inclusion of various substituents around the core structure has resulted in the identification of several benzimidazole derivatives with good pharmacological properties.

A comprehensive pharmacological framework of benzimidazole and its derivatives with outstanding characteristics has been reported in several pieces of literature. Antifungal, antibacterial, antiviral, antiulcer, anti-inflammatory, antituberculosis, antidiabetic, anti-alzheimer, antileishmanial, antiprotozoal, anti-convulsant, antioxidant, anti-hypertensive, analgesic, and antimalarial agents are examples of such drugs. Furthermore, a number of benzimidazole derivatives have been utilised to generate sunburn by employing the product to protect the skin from UV light absorption.

Many benzimidazole derivatives were created and synthesised in high yields using a simple and low-cost method. The compounds were tested for analgesic efficacy *in vitro* and *in vivo*. The di-substituted hybrids exhibited significant analgesic inhibitory activity.

As possible anticancer CDK2 inhibitors, a new set of oxindole Thiazolo 3,2-a Benzimidazole (TBI) scaffolds with non-rigid hydrazide spacers was developed. All of the newly synthesised isatin-TBI was tested for antiproliferation activity against two cancer cell lines, MDA-MB-231 and MCF-7. Furthermore, the compounds with promising efficacy were evaluated for their action against CDK2, impact on cell cycle progression, and induction of apoptosis in cytotoxic assays.

Correspondence to: Lingue Pi, Department of Chemistry, Baoji University of Arts and Science, Baoji, China; E-mail: pi123@gmail.com

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