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SYNTHESIS AND EVALUTION OF NOVEL BENZIMIDAZOLE DERIVATIVES AS POTENTIAL ANTIBACTERIAL AGENT

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ABSTRACT
An imidazole ring's fourth and fifth places can be fused with a benzene ring to form a class of heterocyclic compounds called benzimidazoles. The parent component is known as benzimidazole, and the heterocyclic compounds have the same ring structure but various substituents. O-phenylenediamine and formic acid are condensed to create the commercially accessible benzimidazole. A pharmaceuticals such anthelmintic and antiulcer medications, benzoimidazole and its derivatives are indispensable. Furthermore, analgesic, antiviral, antibacterial, anticancer, and anti-inflammatory activities are among the pharmacological properties of benzimidazole compounds. This article provides an overview of the chemistry and pharmacological properties of substituted benzimidazoles.

KEYWORDS: Benzimidazole, Benzimidazole Derivatives, Antimicrobial activity.

INTRODUCTION

Heterocyclic aromatic organic compounds include benzimidazole. One way to think about this bicyclic molecule is as fused rings of the aromatic chemicals imidazole and benzene. It manifests as tabular crystals and is a white solid.[1]

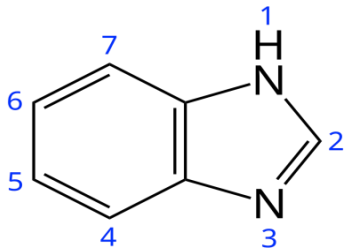

Fig. No. 01: Structure of benzimidazole.

The pharmacological activities of benzimidazole, a nitrogen-containing bicyclic heterocyclic compound, include antibacterial, antiviral, antifungal, anticancer, antihypertensive, antimicrobial, and anti-tumor effects. Benzimidazole is a very useful intermediate in the synthesis of medications and physiologically active compounds. Many researchers have developed various methods for the production of benzimidazoles2 using a range of catalysts, such as zinc acetate, solid acid scolecite, silica boron sulfonic acid (SBSA), bismuth nitrate, VB1, and zinc sulfate. One of the first investigations into the chemical makeup of benzimidazole led to this discovery. Ladenburg eventually managed to reflux acetic acid with 3,4-diamino toluene to get a molecule with similar characteristics. He described his method as "refluxing." Because water was lost during the creation of these compounds, they were referred to as "hydro bases" in the early scientific literature. Before decidingto adopt "benzimidazole" as its permanent appellation, benzimidazoles had a number of different nomenclature phases. It is simple to differentiate between these eras.

Benzimidazole was made from derivatives of o-phenylenediamine, including methyl-ophenylenediamine, and 2-methyl benzimidazole was made from ethenyl-o-phenylenediamine. Alternatively, these compounds have been called derivatives of the imidazole component of the ring. For instance, benzimidazole is also known as o-phenyleneformamidine. These substances are known as these derivatives. Benzimidazole-2 (3H) -thione and 2(3H)-benzimidazoles were originally known as o-phenyl urea and o-phenylenethiourea, although they were more frequently referred to as o-phenyl urea. The use of o-phenylenethiourea is no longer required.[2]

Properties

1. Molecular formula :- C7H6N2
2. Molecular weight :- 118.14g/mol
3. Molar Mass:-118.139g/mol−1

The chemistry of benzimidazole

The benzimidazole nucleus is created when the imidazole ring and benze nucleus join. Benzimidazole is a heterocyclic scaffold that is produced when the imidazole and benzene rings unite at positions four and five. Figure 2. shows how the imidazole and benzimidazole nuclei are numbered.[3]

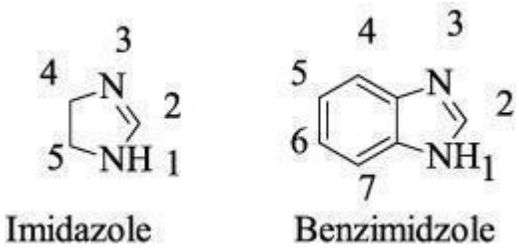

Figure 2.

Procedure of Benzimidazole

54g (0.5mole) of o-phenylenediamine is treated with 32cc (34.6g) of 90% formic acid (0.75 mole) in a 500cc round-bottom flask. The mixture is heated for two hours at 100° in a water bath. A 10% sodium hydroxide solution is gradually added after cooling, and the flask is well mixed by rotating it until the liquid is just alkaline to litmus. A75-mm Buchner funnel is used to suction the crude benzimidazole in to place, and all of the solid is rinsed out of the reaction flask using ice- cold water. After the crude product has been firmly pressed against the filter, it is cleaned with around 50cc of cold water and refined without first drying.[4]

Reaction

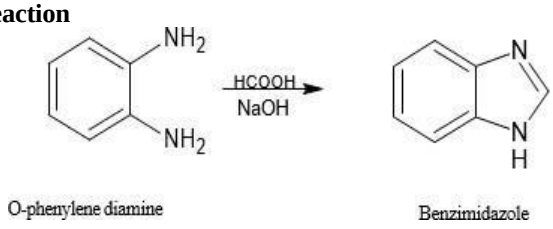

Fig. No. 03: Synthesis of Benzimidazole.

Derivatives of Benzimidazole

a) Synthesis Of 2-methyl-1-H-Benzo(d)imidazole(20)

Procedure:- After combining O-phenylenediamine (3.24g; 0.03mol) with 0.09mol acetic acid in 20ml of 4 N HCL, the mixture was refluxed for five hours. The reaction was observed by TLC. After the reaction was complete, a concentrated ammonia solution was added gradually, and the precipitate that resulted was recrystallized using 10% aqueous ethanol. The melting point ranges from 100 to 102°C.

b) Synthesis Of 2–(3–bromophenyl)–1H–benzo (d)imidazole(2a):- Procedure:- 1,2-phenylenediamine (1.60g,1.47 m mol) was dissolved in 10 ml of arcenicacide with 3-bromobenzaldehyde (3.28g, 1.77m mol) and heated to 85°C for 16 hours. Following reaction completion, the crude solid material was reduced under pressure and dried. 3. Dichloromethane (DCM) was then used to wash the material, yielding 3.21g of the title compound off white solide in its pure state. At 289–291°C, the melting point occurs.[5]

Culture Media

Common ingredients of culture media

1) Peptone- a source of carbon and nitrogen.
2) Beef extract- a source of amino acid, vitamins, minerals.
3) Yeast extract- a source of vitamin, carbon, nitrogen.
4) Distilled water.
5) Agar- a substance that solidifies.[6]

Antibacterial Activity

The bactericidal effects of the essential oils were investigated using the disc-diffusion method. A sterile Whatman disc (6 mm) saturated with benzimidazole at a concentration of 200 mg/ml in ethanol was placed on a lawn of bacterial inoculum (Escherichia coli (E.coli) and Staphylococcus Aureus), which has a turbidity in 1%(w/v) tryptone water equivalent to a Mc-Farland No 0.5 standard (roughly 108CFU/ml).[7]

Fig. No. 04: Antibacterial Activity.

CONCLUSION

The current investigation was carried out to evaluate the synthesis of benzimidazole and its derivatives utilizing thin layer chromatography, paper chromatography, and element analysis in order to ascertain the antibacterial activity of the drug and its derivatives. a variety of biological activities, including as antibacterial ones. The chemistry of many substituted benzimidazole derivatives and their antibacterial properties are compiled in this thorough review. Given their strong antibacterial qualities, the current study emphasizes the importance of benzimidazole and its derivatives as a promising scaffold in the field of medicinal chemistry. The heterocyclic molecule benzoimidazole, which is created when the rings of benzene and imidazole fuse, has a variety of pharmacological properties, such as antibacterial, antiviral, anticancer, anti-inflammatory, and antihypertensive properties. Because of its chemical versatility, benzimidazole can be used to create a wide range of derivatives using simple processes that involve ophenylenediamine and different acids or aldehydes. Several new benzimidazole derivatives were created in this study using conventional condensation methods, and their antibacterial efficacy against common pathogens such as Staphylococcus aureus and Escherichia coli was assessed. A number of the synthesized compounds were found to have strong antibacterial activity by the disc-diffusion method, indicating their potential as lead structures in the creation of novel antimicrobial drugs. The bioactivity was further increased by the addition of functional groups like methyl or bromophenyl moieties, demonstrating the structure-activity relationship (SAR) that is essential for further optimization. All things considered, the study highlights the therapeutic significance of benzimidazole derivatives and offers insightful information about their synthesis and bioevaluation. The creation of new, potent antibacterial drugs to counteract the growing threat of antimicrobial resistance may be made possible by further investigation and modification of the benzimidazole core.

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