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A Review on Benzofuran Derivatives and Its Biological Activities

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ABSTRACT

Benzofuran derivatives make up a significant portion of the collection of physiologically active heterocycles found in nature. Individual benzofurans have a wide range of pharmacological activity, demonstrating the undeniable interest in this class of chemicals. Due to their strong biological activity and prospective use as pharmacological agents, benzofuran and its derivatives have drawn the attention of medicinal chemists and pharmacologists. Benzofurans exhibit a wide range of biological functions, which has sparked interest in the structure–activity connections of these compounds among medicinal chemists. This research has led to the identification of multiple lead molecules in a variety of illness situations. The remarkable progress benzofuran derivatives have made in treating a variety of ailments in a very short period of time attests to their importance for medicinal chemistry research. With an update of recent research discoveries on this nucleus, the current study aims to highlight the development in the diverse pharmacological actions of benzofuran derivatives in the existing literature.

Keywords: Structure activity relationship, Benzofuran, Antimicrobial activity, Antitubercular activity

I. INTRODUCTION

In organic chemistry, heterocycles play a key role. These substances are a crucial component of both the chemical and life sciences, and a sizable portion of current global research is focused on these substances. Heterocyclic ring systems have become effective testing platforms for a variety of biological processes. These substances are crucial in the development and identification of novel molecules with physiological or pharmacological activity. Pharmacophores can assemble on heterocyclic molecules to produce effective and selective medicines. Both the agrochemical and pharmaceutical industries are looking for new bioactive compounds, and these are of particular interest and significance. In fact, over 60% of the top-selling medications have at least one heterocyclic nucleus as part of the compound's overall topography, making heterocyclic themes particularly common with regard to the pharmaceutical business. Additionally, compounds with heterocyclic moieties frequently have enhanced solubilities and the capacity to stimulate salt formation—both of which are known to be crucial for oral absorption and bioavailability. **(Khanam H et al., 2014)**

Strong biological features such as analgesic, antiparasitic, antibacterial, anticancer, and kinase inhibitor activity are displayed by benzofuran derivatives. Additional uses for substituted benzofurans include fluorescence sensors, oxidants, antioxidants, brighteners, a variety of pharmaceuticals, and other chemistry and agricultural fields. Additionally, a large variety of natural items include benzofurans. Numerous natural benzofurans have pharmacological, poisonous, and physiological characteristics. In particular, isolated benzofuran ring structures from Machilus glaucescens, Ophryosporus charua, Ophryosporus lorentzii, Krameria ramosissima, and Zanthoxylum ailanthoidol are well recognised natural products. The chemicals ailanthoidol, amiodarone, and bufuralol are the most well-known benzofurans. It has been claimed that ailanthoidol, a neolignan with a 2-arylbenzofuran structure, has a number of biological actions, including anticancer, antiviral, immunosuppressive, antioxidant, antifungal, and antifeedant activities. **(Miao Y H et al., 2019)**

II. CHEMISTRY

A heterocyclic substance called benzofuran is made up of a fused benzene and furan ring (Fig. 1). This invisible fluid is a part of coal tar. The "parent" of other similar compounds with more intricate structures is benzofuran. These heterocyclic compounds exhibit a wide variety of pharmacological characteristics, and altering their structural makeup results in a high degree of diversity that has been helpful in the quest for new medicinal medicines. Individual benzofurans have a wide range of pharmacological activity, which suggests that this group of molecules is unquestionably interesting. This suggests that synthetic approaches may be a very helpful tool in the creation of particular structures with a specific set of pharmacological properties.

Additionally, from the standpoint of drug discovery, the synthesis of substituted benzofurans may be more intriguing because they may serve as raw materials for the creation of molecules that have biological activity. The synthesis of benzofurans can be carried out by a variety of synthetic pathways. Hypervalent iodine reagents facilitate an easy metal-free cyclization of ortho-hydroxystilbenes into 2-arylbenzofurans and 2-aryl naphthofurans. Desired compounds can be separated with good yields using stoichiometric (diacetoxyiodo) benzene in acetonitrile. A broad range of substrates can be used in a one-pot benzofuran synthesis that uses a palladium-catalyzed enolate arylation to produce benzofurans with differential substitutions in moderate yields. The synthesis of the natural substance eupomatenoid in three steps further demonstrates the method's usefulness. **(Miao Y H et al., 2019)**

Ruthenium-catalyzed C- and O-allyl isomerization followed by ring-closing metathesis can be used to create substituted benzofurans from their corresponding substituted 1-allyl-2-allyloxybenzenes. The production of benzofurans and isochromenes through an efficient, Ru-catalyzed cycloisomerization of benzannulated homo- and bis-homopropargylic alcohols (5- and 6-endo cyclizations) is chemo- and regioselectively. For the catalytic cycle to function, an amine/ammonium base acid pair must be present. To produce the benzofuran derivatives, a significant number of aryl- and heteroaryl silanols that are electron-rich, electron-poor, and sterically hindered undergo effective cross-coupling with a variety of aromatic bromides and chlorides. **(Khanam H et al., 2014)**

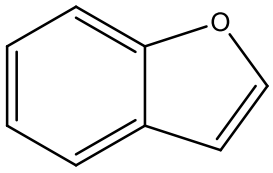


Figure -1 Benzofuran Nucleus (Khanam H et al., 2014)

BENZOFURAN DERIVATIVES'S BIOLOGICAL ACTIVITIES

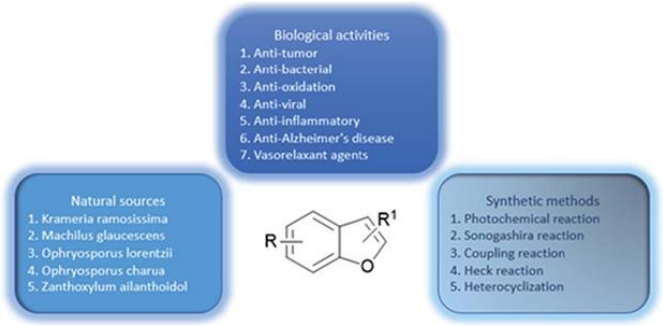


Figure 2- Natural sources, Biological Activities and Synthetic methods of Benzofuran derivatives (Miao Y H et al., 2019)

Ethyl 4-(benzofuran-2-yl)-2,4-dioxobutanoate with two moles of hydrazine hydrate gives 5-(benzofuran-2-yl)-1H-pyrazole-3-carbohydrazide 4a, while its reaction with equimolar amount of phenyl hydrazine gave ester 3b which then converted to 5-(benzofuran-2- yl)-1-phenyl-1H-pyrazole-3-carbohydrazide 4b. The carbohydrazide derivatives 4a, b were used to create a number of novel compounds, including imides 5 and 6, acyl hydrazones 7 and 8, bi-pyrazoles 9–12, and 1,3-thiazole derivatives 14 and 15. The novel substances are examined for their capacity to inhibit microorganisms. Against Candida albicans, compounds 2, 5, 7, and 8 shown antifungal properties. Additionally, substances 2, 6, 8, and 15 demonstrated antibacterial properties. **(Abdel-Wahab et al., 2008)**

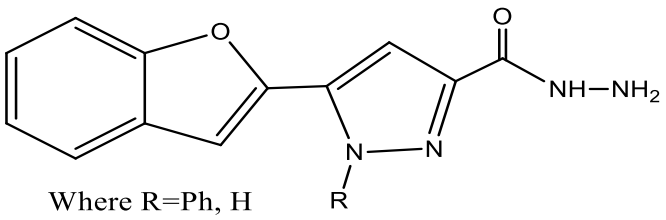


Figure 3- Benzofuran derivatives-1

The preliminary antitubercular activity of the fifteen benzofuran-oxadiazole derivatives 7(a-o) against Mycobacterium phlei and Mycobacterium tuberculosis strain H37RV has been developed, synthesised, characterized, and tested. According to the results of the structure activity relationship (SAR), benzofuran-containing compounds with chlorine (7j, 7k) and bromine (7l, 7m) demonstrate outstanding activity. Molecular docking data provided additional support for the 7m medication's superior to standard medicine pyrazinamide maximum activity. Utilizing molecular docking investigations on these new hybrids, the in vitro antitubercular experimental findings and structure activity relationship studies were supported. **(Negalurmath V.S et al., 2019)**

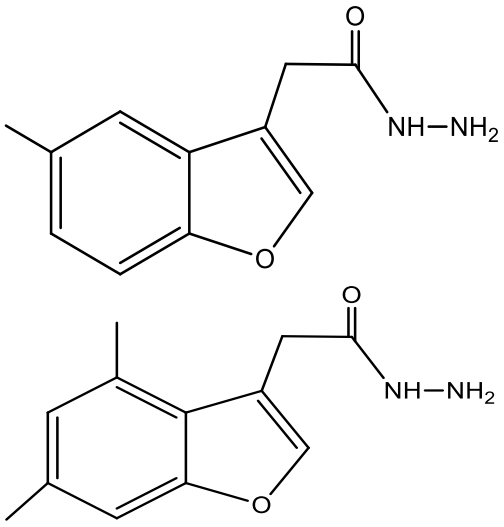


Figure-4- Benzofuran derivatives-2

New Schiff bases for derivatives of 2-(1-benzofuran-2-yl)quinoline-4-carboxylic acid In the presence of catalytic amounts of acetic acid, 2-(1-benzofuran-2-yl) quinoline-4-carbohydrazide 3 and substituted aromatic aldehydes 4a-4e were combined to form 5a-5e. After refluxing in ethanol for four hours, methyl 2-(1-benzofuran-2-yl)-quinoline-4-carboxylate 2 and hydrazine hydrate produced the crucial intermediate, hydrazide molecule 3. The IR, NMR, and mass spectra

were used to characterize all freshly synthesised compounds, and their antibacterial and antitubercular activity was tested. With MIC values of 0.064 mg/mL, the examined compounds carbohydrazide 3 and compounds 5a and 5e shown strong activity against S. aureus and E. faecalis, respectively. With a MIC of 0.064 mg/mL, compound 5e showed notable efficacy against S. aureus and E. faecalis. In the antibacterial assays, the hydrazide derivative 3 showed high activity among the synthesised compounds with sensitivity at 25 g/mL.**(Bodke Y.D et al., 2017)**

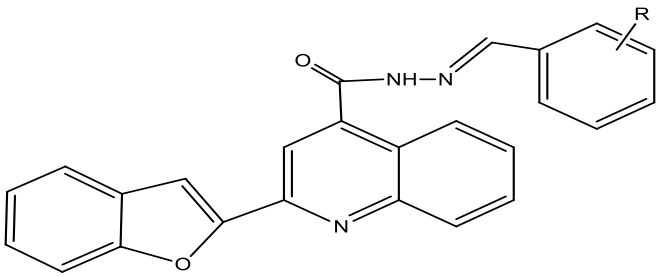


Figure-5- Benzofuran derivatives-3

A total of 17 2, 3-diaryl benzofuran hybrids were created, synthesised, and tested for their anti-tubercular potential against the virulent strain of Mycobacterium TB known as H37Ra as part of our drug development programme for anti-tubercular medicines. With MIC values ranging from 12.5 to 50 g/mL, four of the seventeen derivatives shown substantial activity against the M. tuberculosis H37Ra virulent strain (ATCC 25177). The molecular docking score (-8.4) compared to the first-line anti-tubercular medication, isoniazid (-6.2) on the target Polyketide Synthase-13 was further evidence that one derivative (9E) out of four was considerably active (MIC 12.5ug/mL). By using the MTT assay to test all the derivatives' cytotoxicity against the normal lung cell line L-132, it was discovered that none of them were harmful up to a concentration of 27.4 g/mL. The development of anti-tubercular medications may benefit greatly from this information on the antitubercular potential of benzofuran derivatives. **(Bhukya B et al ., 2020)**

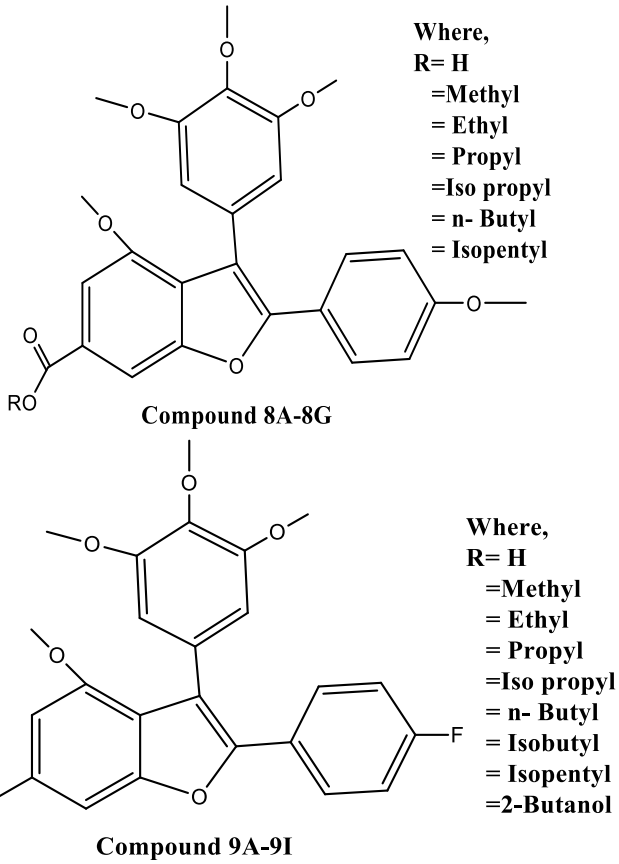
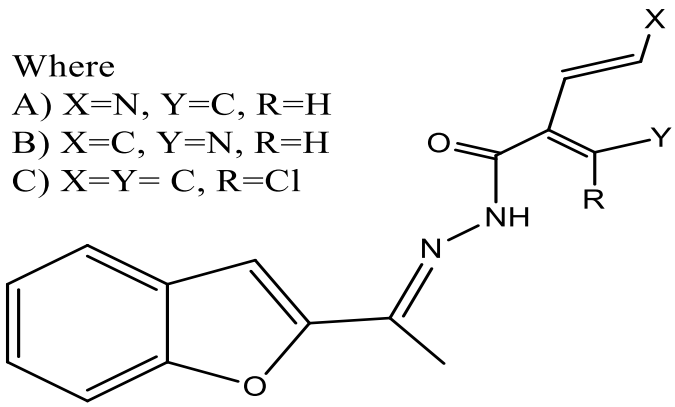


Figure-6- Benzofuran derivatives-4

The benzofuran-based hydrazone derivatives BEINH, BFENH, and BECBH were created and characterized using FTIR, 1HNMR, MS spectroscopic, and SC-XRD methods. Furthermore, using B3LYP level of density functional theory (DFT), which includes 6-311G(d,p) basis set, the structural geometrical parameters, vibrational bands, natural bond orbitals (NBOs), natural population analysis (NPA), molecular electrostatic potential (MEP), linear and nonlinear optical (NLO) properties of the BEINH, BFENH, and BECBH were rationalized. It was therefore possible to get a superb complement between the experimental data and the DFT-based results. For BEINH, BFENH, and BECBH, respectively, the strongest

hyper conjugative interactions were discovered, and related stabilisation energies of 67.52, 59.61, and 48.35 kcal/mol may be the reason for their stability. In order to effectively polarize the chemical structures, the band gaps (Egap) of BEINH, BFENH, and BECBH were rationalized to be 3.814, 3.903, and 3.727 eV, respectively. The title compounds' average linear polarizability is in the following order: BECBH> BEINH>BFENH. According to the results, among the title compounds, BEINH had the highest betatot value (3591.872 a.u.), while BECBH had the lowest value (2242.707 a.u.). The betatot was seen in the following decreasing order: BEINH>BFENH>BECBH. The NLO characteristics of the title compounds were also discovered to be bigger than the reference material. **(Khalid M et al., 2020)**



Compound 3A-3C

Figure-6- Benzofuran derivatives-4

III. REFERENCES

[1]. Abdel-Wahab B.F., Abdel-Aziz H.A and Ahmed E.M., Convenient Synthesis and Antimicrobial Activity of New 3-Substituted 5-(Benzofuran-2-yl)-pyrazole Derivatives. Arch. Pharm. Chem. Life Sci. 2008, 341, 734 – 739.

[2]. Negalurmath V.S., Boda S.K., Kotresh O, Anantha Lakshmi. P. V and Basanagouda M., Benzofuran-oxadiazole hybrids: Design, synthesis, antitubercular activity and molecular docking studies. Chemical Data Collections. 2019,01-51.

[3]. Bodke Y.D., Shankerrao S. Kenchappa R. and Telkar S. Synthesis, Antibacterial and Antitubercular Activity of Novel Schiff Bases of 2-(1-Benzofuran-2-yl) quinoline-4-carboxylic Acid Derivatives. Russian Journal of General Chemistry, 2017, Vol. 87, No. 8, pp. 1843–1849.

[4]. Bhukya B., Shukla A., Chaturvedic V., Trivedic P., Kumard S., Khan F., Negia A S and Srivastavaa S K. Design, Synthesis, In vitro and In silico Studies of 2, 3-diaryl Benzofuran Derivatives as Antitubercular agents. Bioorganic Chemistry (2020), 01-31.

[5]. Khalid M., Arshad M N., Tahir M N., Asiri A M., Naseer M M., Ishaq M., Khan M U., Shafiq Z., An efficient synthesis, structural (SC-XRD) and spectroscopic (FTIR, 1HNMR, MS spectroscopic) characterization of novel benzofuran-based hydrazones: An experimental and theoretical. Journal of Molecular Structure 1216 (2020) 128318.

[6]. Khanam H and Shamsuzzaman. Bioactive Benzofuran derivatives: A review. European Journal of Medicinal Chemistry xxx (2014) 1-22

[7]. Miao Y H., Hu Y H., Yang J., Liu T., Sun J and Wang X J. Natural source, bioactivity and synthesis of benzofuran derivatives. RSC Adv., 2019, 9, 27510.

[8]. Mehnaz K., Ashok K and Talha J. International Journal of Medical and Pharmaceutical Sciences, 2011, 1, 1–15.

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