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Synthesis and evaluation of oxadiazole derivatives in drug design and development

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Abstract
The current review summarizes synthesis and biological activity of the oxadiazole derivatives to date. The results described in the review are of high significance and priority for the development of new approaches in the drug design and discovery. Numerous advances have been achieved in the synthetic methodologies during the last years, which allowed obtaining a number of novel and diverse structural scaffolds. This has dramatically expanded the functionalization and derivatization potential of these heterocyclic compounds and translated them from a kind of laboratory product into an important part of the therapeutically valuable molecules. The review summarizes succintly information on newly emerging and traditional approach for development of small oxadiazoles and their biological activity and illustrates the impact of the oxadiazoles derivatives on human pharmaceutical development.

Keywords: Oxadiazole derivatives, Heterocyclic synthesis, Structure-activity relationship, Drug design and Pharmacological evaluation

Introduction
Oxadiazole derivatives are heterocyclic compounds that include five-membered rings with oxygen and two nitrogen atoms. Oxadiazoles have distinctive chemical and pharmacological characteristics as a result of this structural feature. Over the past few decades, there has been an increasing focus on the use of such frameworks in medicinal chemistry since they can lead to various biological activities and can be used as versatile scaffolds in the design of new drugs. The purpose of this research work is to write the account on the synthesis, functionalization and biological evaluation of oxadiazole derivatives. The emergence of new synthetic methods and strategies to optimize biological activity and their contribution to the creation of new drugs is covered in a systematic way, starting from chemical design and ending with pharmacological evaluation. This article discusses the relevant issues regarding the oxidative cleavage of various oxadiazoles and their derivatives in formulating the synthetic approaches. The structural features, areas of application and other important data are given for more detailed information. The account provides a detailed information about oxadiazoles with their extensive analytical reports.

Structural Features and Classification of Oxadiazoles
The skeletal framework of oxadiazoles is a five-member heterocyclic aromatic ring, comprising two nitrogen and one oxygen atom in three isomeric structures (1, 2, 4-, 1, 3, 4-, and 1, 2, 5-) with specific distinctions in their spatial arrangement. The order and position of the heteroatoms in this cyclic framework change the inherent chemical properties and hence its further use in medicinal chemistry. Structurally, the 1, 2, 4-oxadiazoles have been identified to show remarkable bioisosteric effect which helps them to function in drug molecules as a substitute of amides making them an important candidate to modify pharmacokinetic and pharmacodynamic (Biernacki *et al*., 2020) [3]. Moreover, the structural distribution in 1, 3, 4-oxadiazoles are often reported with a wide range of biological activities that can be attributed to their electronic dispersion and stability (Ajani & Iyaye, 2020) [1]. Likewise, the divergent configurational strucutres possess varying physicochemical properties that could be important to modify their target specificity in drug development. Table 1 summarizes the major oxadiazole isomers, their commonly used synthetic precursors, and reaction methodologies employed for their preparation. The table highlights that 1, 2, 4- and 1, 3, 4-oxadiazoles are the most widely explored frameworks in medicinal

chemistry due to their synthetic accessibility, chemical stability, and bioisosteric properties. Classical cyclization methods using hydrazides and amidoximes remain popular; however, modern approaches such as microwave-assisted and green synthesis offer significant advantages including shorter reaction times, higher yields, scalability, and environmental safety. Overall, the table emphasizes the evolution from conventional synthesis to efficient, eco-friendly methodologies that support large-scale drug discovery programs.

Table 1: Major Classes of Oxadiazoles, Synthetic Approaches, and Key Features

Oxadiazole Isomer	Common Synthetic Precursors	Key Reagents / Conditions	Advantages of the Method	Representative References
1, 2, 4-Oxadiazole	Amidoximes + carboxylic acids/esters	$POCl_3$, PPA, CDI, microwave-assisted cyclization	Acts as amide bioisostere, improves metabolic stability, good yield	Biernacki *et al*., 2020; Zhu *et al*., 2020
1, 3, 4-Oxadiazole	Acyl hydrazides + carboxylic acids/aldehydes	Dehydrating agents ($POCl_3$, $SOCl_2$), oxidative cyclization	High chemical stability, wide biological activity spectrum	Ajani & Iyaye, 2020; Khamkar *et al*., 2025
1, 2, 5-Oxadiazole (Furazan)	Vicinal dioximes	Oxidative cyclization (HgO, PbO_2)	Strong electron-withdrawing nature, niche applications	Kumar *et al*., 2017
Microwave-assisted synthesis	Hydrazides / amidoximes	Solvent-free or minimal solvent, microwave irradiation	Short reaction time, high yield, eco-friendly	Zhu *et al*., 2020; Sulman *et al*., 2025
Green chemistry approaches	Recyclable catalysts, solvent-free systems	Ionic liquids, reusable catalysts	Reduced waste, scalable, environmentally benign	Sulman *et al*., 2025

Also, heterocyclic structures are important scaffolds for the design of medicinal compounds that imitate the structural properties of biochemical substrates and provide diversity of functional groups for interaction with biological targets. In particular, oxadiazoles are considered privileged scaffolds due to their tunable electron mobility, planar rigid structure, and multiple functionalization. Oxadiazole cores are highly prone to participating in biologically relevant activities, which allows rational design for highly active drugs for therapeutic use on challenging diseases. It has been found that oxadiazole scaffolds exhibit higher bioactivity than the majority of heterocyclic scaffolds in many cases, especially regarding the inhibition of HIV and cancer-related enzymes, emphasizing the significance of this scaffold in contemporary drug discovery (Kumar). The mentioned properties, together with the well-established success of optimization of oxadiazole-based derivatives for different pharmacological activities, stimulate further research on structural modifications of these compounds directed to the prospective synthesis of new drugs.

Methods of Synthesis of Oxadiazole Derivatives

The generation of oxadiazole derivatives is traditionally based on classical cyclization/condensation reactions, which already have clear procedures for the assembly of their heterocyclic cores. Among the most used cyclization routes are those involving the reaction of hydrazides and derivatives of carboxylic acids under dehydrating conditions, a method that is still very popular for the synthesis of oxadiazole isomers. Condensation reactions also make it possible to quickly obtain the framework of 1, 2, 4- and 1, 3, 4-oxadiazoles using hydrazines and carbonyl compounds, which have proven to be simple and versatile methods (Khamkar *et al*., 2025) [6]. Another promising route to obtain oxadiazole derivatives is based on oxidative cyclization methods; reagents such as POCl3 or polyphosphoric acid accelerate the reactions, increase the variety and yield of the final products formed from various precursors. In general, classical synthetic approaches find their application in medicinal chemistry, allowing the rapid generation of structurally diverse oxadiazole derivatives for further biological tests.

New methodological approaches to synthetic procedures of the oxadiazole derivatives production have also been established in the last years due to synthetic methodology improvements. Modern synthetic procedures, such as microwave-assisted synthesis, demonstrated their ability to optimize active 1, 2, 4-oxadiazole derivatives production in terms of efficiency and eco-compatibility. Especially the microwave-assisted synthesis allowed significant reduction of time and increase of the yield of the reaction, as well as contributed to further generation of new oxadiazole core structures. The green chemistry principles encouraging the minimum consumption of solvents and the application of safe reagents and starting materials contributed to the efficient and eco-conscious synthesis of active 1, 2, 4-oxadiazole derivatives. It was established in the studies that solvent-free new synthetic approaches and eco-approaches, such as usage of recyclable catalysts, ensured reduction of toxic by-products and hazards waste, as well as the enhanced practicality of active 1, 2, 4-oxadiazole derivatives obtaining (Zhu *et al*., 2020) [15]. Methodological innovations in the 1, 2, 4-oxadiazole derivatives production are of particular importance in medicinal and agrochemical chemistry to satisfy high demand for the highly efficient and low waste processes in future drug discovery.

Alternatively, modern synthetic methodologies for oxadiazoles derivatives are more efficient than conventional methodologies. They have a higher yield and the yields correlate with their capability for scale-up (Sulman *et al*., 2025) [12]. Conventional reactions, although reliable, generally gives a lower yield and require longer reaction time. These two disadvantages limit its scalability for the intended use in drug development. Microwave-assisted synthesis and green chemistry approaches favor shorter reaction times and higher and more reproducible yields and both can be scaled-up (Sulman *et al*., 2025) [12]. Besides supporting the generation of diverse oxadiazole structures, the move from conventional to modern synthesis also favors oxadiazole derivatives' application in drug development because of the need for rapid and efficient approaches for producing libraries of synthetic compounds and the ease at which they can be scaled-up to industrial levels.

Functionalization and Derivatization Strategies

The area for enhanced biological application is centered around the rational functionalization of the heterocyclic scaffold through selective substitutions and incorporation of

pharmacophoric groups in oxadiazole derivatives. Oxadiazole ring accepted different substituents that modify the electronic nature and steric effect which are directly correlated with the interactions with biological targets, as a result, ultimately biological activity is affected. The position and nature of substituents on the oxadiazole ring is particularly highlighted in oxadiazole for the study of structure-activity relationships (SAR) associated with the enhanced activity and pharmacokinetic properties (Boudreau *et al*., 2019) [4]. Substituent modification on the oxadiazole ring at selected positions showed significant enhancement in activity and oral bioavailability accompanied by derivatives with desired activity profiles. In addition, selective functionalization by attaching groups to the oxadiazole ring with the ability to enhance membrane permeability or binding capacity can extend therapeutic activity as original lead compounds with promising results in preliminary evaluation (Boudreau *et al*., 2019) [4].

Regioselective synthesis of oxadiazole derivatives may be technically challenging particularly targeted are the specific isomeric forms or complex substituation. To obtain the desired orientation of substituents on the hetero-ring, the selective choice of starting materials and the proper control of reaction conditions are required, there may be alternative reaction routes that lead to undesired regioisomer. This grows even harder in obtaining the 1, 3, 4-oxadiazole-quinoline hybrids, within which multiple reactive sites lead to a mixture of products unless certain rules of obtaining are carried out (Sharma *et al*., 2023) [11]. Progress in methodology such as the use of particular catalysts and assembly in steps has achieved advancing in selectivity for the preferred regioisomers over other products, undesirable byproducts. However, this progress is yet to be polished due to the fact that slight deviations from the optimal reaction parameters may result in decreased yield or purity and therefore demand for continued progress in synthetic design (Sharma *et al*., 2023) [11].

Biological Activities of Oxadiazole Derivatives

The derivatives of oxadiazole possess a broad range of biological activities, covering antifungal, anticancer, anti-inflammatory, antimicrobial, and antiviral characteristics. In particular, oxadiazole derivatives show great promises as antimycotic and anti-tubercular drugs to combat fungal infections and drug-resistant microbial isolates (Atmaram & Roopan, 2022) [2]. The isomers of oxadiazole with the heterocyclic structure, such as 1, 2, 4-oxadiazole or 1, 3, 4-oxadiazole, are used in a structure-based drug design generation, providing antivirals like Raltegravir and Pleconaril (Mishra *et al*., 2020) [9]. The biological data on structure-activity relationship and molecular docking simulation were employed to achieve the desired properties of oxadiazole derivatives in the anticancer and anti-HIV activity. The properties of oxadiazole derivatives can be modified by the choice of an isomer and a molecular scaffold, and now these compounds lay a solid foundation for a generation of new drug candidates.

In the reported literature, a representative example of this trend relates to the discovery of 1, 3, 4-oxadiazole derivatives containing di-, tri- or poly-aromatic substituents as promising hits in anticancer drug development. The investigated compounds frequently demonstrated significant cytotoxic activity against numerous cancer cell lines due to the flexible character of the oxadiazole motif that allows greatly varying its structure. It should be noted that numerous aromatic and heterocyclic substituents on the 1, 3, 4-oxadiazole fragment are associated with particular mechanisms of action, which allow the compound to block key cellular processes directly related to tumor progression and cell proliferation. As it has been established recently, the 1, 3, 4-oxadiazole derivatives exert their effects in multidrug-resistant tumors, which underscores their promising potential as alternative agents that can overcome the limitations of standard chemotherapy. The rising number of publications in this area suggests that the interest in this class of compounds will increase, and new oxadiazole motifs aimed at the selective intervention of particular biological processes associated with a certain disease will be created (Vaidya *et al*., 2020) [13]. Table 2 provides an overview of the diverse biological activities of oxadiazole derivatives and correlates them with specific isomeric forms, structural features, and therapeutic targets. The table demonstrates that 1, 3, 4-oxadiazole derivatives dominate anticancer, antiviral, and antitubercular research due to their ability to interact with critical biological pathways such as STAT3 signaling and enzyme inhibition. The presence of aromatic, halogenated, or heterocyclic substituents significantly enhances biological activity and selectivity. Furthermore, the inclusion of clinically approved and investigational drugs confirms the translational potential of oxadiazole scaffolds from laboratory research to clinical application, reinforcing their importance in modern drug design.

Table 2: Biological Activities of Oxadiazole Derivatives and Representative Drug Candidates

Biological Activity	Oxadiazole Isomer	Structural Features / Substituents	Mechanism / Target	Representative Drugs or Leads	References
Anticancer	1, 3, 4-Oxadiazole	Aromatic / heteroaromatic substituents	STAT3 inhibition, apoptosis induction	ODZ10117	Kim *et al*., 2019; Vaidya *et al*., 2020
Antiviral (HIV)	1, 3, 4-Oxadiazole	Polar heterocyclic scaffolds	HIV integrase inhibition	Raltegravir	Kumar *et al*., 2017; Mishra *et al*., 2019
Antimicrobial	1, 2, 4- & 1, 3, 4-Oxadiazole	Halogenated phenyl rings	Cell wall synthesis inhibition	Experimental leads	Atmaram & Roopan, 2022
Antitubercular	1, 3, 4-Oxadiazole	Benzofuran / halogen substitutions	Mycobacterium tuberculosis enzyme inhibition	Preclinical analogues	Verma *et al*., 2020
Anti-inflammatory	1, 2, 4-Oxadiazole	Bioisosteric amide replacement	COX and cytokine modulation	Investigational compounds	Rana *et al*., 2020
Neurodegenerative disorders	Oxadiazole hybrids	Lipophilic substituents	Receptor modulation (M4, S1P1)	Zibotentan (clinical stage)	Hassan *et al*., 2022

Additionally, recently conducted structure-activity relationship (SAR) studies have identified vital links between various chemical alterations on a particular series of oxadiazole derivatives and variations in their biological activity. In a drug discovery program on tuberculosis, the hydrazide moiety was bioisosterically replaced with the oxadiazole ring to render derivatives with enhanced activity against Mycobacterium tuberculosis. This is an example of rational scaffold manipulation (Verma *et al*., 2020) [14]. The presence of halogenated substituents such as chlorine and bromine in the benzofuran-oxadiazole analogues have shown a positive relationship with increased anti-tubercular activity. This indicates that subtle changes in the aromatic rings have a significant impact on the pharmacological activity of the target compounds. The results obtained from SAR studies demonstrate the impact of selective introduction of functional groups on the efficacy and selectivity of a given compound series. These results further support trends identified in the development of oxadiazole derivatives as therapeutics agents, whereby changes to the chemical structure of the base molecule resulted in a demonstrable change in activity (Verma *et al*., 2020) [14].

Advances in Drug Design Using Oxadiazole Derivatives

Currently, rational drug development starts focusing on virtually combining oxadiazole moiety as azole derivatives have shown multiple functionalities which could be explored using docking and computer aided molecular design. Computer-aided drug design processes focus on selection of potential oxadiazole-like scaffold molecules based on binding affinities, molecular docking studies, molecular interaction with biologically relevant macromolecules and structure-activity relationships. Consequently, these computational drug designs have characterized the pharmacophoric elements in oxadiazole-type compounds which could lead toward selective development of drugs in varied profiles for therapeutic targets such as cancers and neurodegenerative diseases (Hassan *et al*., 2022) [5]. In addition, in silico receptor screening, ligand-based design has also requisitioned several existing oxadiazole derivatives along with newly discovered compounds to target receptors involved in chronic dispensaries. Hence, computational and synthetic design harmonization may develop collectively on systematic usage of oxadiazole-like scaffold frameworks in current drug discovery procedures (Hassan *et al*., 2022) [5].

In addition, recent advances in targeted design of oxadiazole drugs have delivered new disease-relevant candidates, especially in the area of cancer. A clear illustration of these progress is oxadiazole based small molecule ODZ10117, which specifically targets and disrupts STAT3 signaling pathway responsible for many cancer varieties (Kim *et al*., 2019) [7]. Selective binding of ODZ10117 to the SH2 domain of STAT3 blocks Tyr- phosphorylation and dimerization, and restricts nuclear translocation and transcriptional activity associated with tumor growth (Kim *et al*., 2019) [7]. The *in vivo* studies on breast cancer models revealed that ODZ10117 inhibits cell migration/invasion, reduced tumor growth and extended life of the animals, demonstrating its improved disease-relevant efficacy compared to the earlier compound (Kim *et al*., 2019) [7]. The disease-relevant efficacy of ODZ10117 is due its selectivity for the STAT3 and lack of off-target effects on related proteins (Kim *et al*., 2019) [7].

Also, the prime significance of using oxadiazole scaffolds is to tune drug-like properties such as solubility, chemical stability, and bioavailability etc., which are critical for the development of a successful drug. The electronic profile and structural diversity of oxadiazole rings render them suitable to act as bioisosteres of frequently used functional groups and allowed the introduction of changes that can boost aqueous solubility without jeopardizing biological effect or better bioactivity. The replacement of frequently used groups with 1, 3, 4-oxadiazole cores has reported that medicinal chemists have revealed enhanced metabolic stability and superior pharmacokinetics leading to improved *in vivo* performance (Rana *et al*., 2020) [10]. These scaffolds are competent for the design of orally bioavailable agents as well because their incorporation often shows promising absorption and distribution properties. The modularity and extreme stability of oxadiazole derivatives may ensure a significant impact on both physicochemical and therapeutic demands for contemporary drug candidates thereby strengthening their applications for sophisticated drug design in the future (Rana *et al*., 2020) [10].

Case Studies: Approved and Investigational Drugs

The analysis of selected drug-development case studies promises to provide the necessary context for the therapeutic impact of oxadiazole motifs in the context of modern drug development efforts. Among the reviewed classes of therapeutically relevant examples, drugs and candidate drugs with 1, 3, 4-oxadiazole cores have been recorded among the approved drugs and clinical candidates. Such compounds contributed to the pharmacological and physicochemical properties of the marketed products. For example, Raltegravir, an antiretroviral drug for HIV treatment, is based on a compound with proven successful translational potential from the laboratories of medicinal chemistry to modern clinics. The core of 1, 3, 4-oxadiazole, introduced into the target structure of the drug, ensured both everbalance between viral integrase inhibition and biological properties, including specific metabolism. Like drugs, translational molecular targets remain promising objects for further study in clinical trials. Drugs under active study demonstrate the advanced development of oxadiazole derivatives in oncology and anti-infectives. The recorded stability and extensive biological activity spectrum of the class have received an urgent application for targeted delivery in specific diseases (Ajani & Iyaye, 2020) [1]. The compounds showcase the successful implementation of oxadiazoles in preclinical studies aimed at a promising expansion of their therapeutic potential. In all summarized examples, the oxadiazole building block maintains its role in supporting efficacy and safety, as well as influencing target pharmacokinetics. This role has been consistently confirmed; therefore, it is natural to assign them the status of high-value building blocks in the innovation grid of pharmaceutical research.

On the other hand, despite the tremendous benefits that the oxadiazole scaffolds bring to drug discovery and development, the entire process remains challenged by ongoing issues, particularly with toxicity and metabolic concerns. Some oxadiazole derivatives showing promising improvements in metabolic stability also exhibited off-target effects in the preclinical and clinical stages, such is linked to the ability of some compounds to be bioactivated into reactive intermediates. This may further enhance

cytotoxicity or disrupt crucial enzymatic pathways, warranting extensive optimization via structural modifications and safety evaluations (Sulman *et al*., 2025) [12]. Though the oxadiazole framework's electron-deficient nature provides significant defense against rapid metabolic breakdown, the same characteristic sometimes contributes to the agents' incidental accumulation in certain tissues and a risk for long-term toxicity or organ-specific toxicity. With this, the pharmacological optimization of oxadiazole-based drugs essentially revolves around optimal metabolic stability and minimal toxicity trade-off, highlighting a significant complication in "promising" drug development through oxadiazole derivatives (Sulman *et al*., 2025) [12].

Serviceable for the continued evolution of patenting these compounds as lead candidates aimed at addressing current medical unmet needs is its continued expansion into clinical developments. Evidence can be gleaned, for instance, through a prospect of many of the more currently ongoing clinical trials and investigational agents, employing oxadiazole derivatives as core pharmacophores within drug designs. Prominent among these is zibotentan, an oxadiazole-based agent, furthering into the now active clinical stage of development, most especially into current therapies for cancer. Zibotentan has gained an industry interest for the drug's tumor-targeted activity and corresponding cleansing toxicity, enabling further exploration of the compound in several multi-phase trials. Other oxadiazole-based investigational compounds employ the known pharmacological properties of oxadiazole motifs in modulation of various receptors, including the M4 muscarinic receptors and the S1P1 receptor, as other lead candidates aim for novel interventions for symptomatic relief against chronic and neurodegenerative conditions (Hassan *et al*., 2022) [5]. Coupled with the reported upward trend in lead candidate discoveries and advancements, supported through the growing body of available literature on oxadiazole chemistry, such clinical developments further emphasize the potential of oxadiazole-enabled candidates in future therapeutic explorations promising next-generation drug products.

Evaluation Methods and Pharmacological Testing

Standard *in vitro* and *in vivo* assays are employed to perform an exhaustive evaluation for pharmacological activity and toxicity profiles for oxadiazole derivatives. Cell free and enzyme inhibition studies are categorized under standard *in vitro* assays which allows initial screening process as these tests are rapid, resource saving and allow high-throughput analysis. Initial screening provides valuable insight in terms of potency, selectivity, and mechanism of action which leads towards further optimization of drug development (Khamkar *et al*., 2025) [6]. As a standard practice, for biological characterization *in vivo* models are explored for pharmacokinetics, therapeutic effects, toxicity assessment, etc. as these assays predictions are reliable indicators which reveals at the potential for clinical application. Moreover, toxicity profile is an integral consideration for standard screening assays complying with acute, and chronic studies, which eventually favor oxadiazole derivatives with evident promising pharmacological properties to advance forward with tolerable safety profile (Khamkar *et al*., 2025) [6].

Furthermore, ADMET profiling plays a crucial role in oxadiazole derivative screening, as it provides essential insight regarding a compound's pharmacokinetic properties that can help in honing in on ideal drug candidates. Understanding a derivative's absorption and distribution characteristics enables researchers to predict the extent to which oxadiazoles will reach targeted tissues. Knowledge regarding metabolic pathways and means of excretion also provide early estimates of a compound's duration of pharmacological activity along with accumulation or elimination potential. These assessments assist in further reducing adverse effects, enhancing therapeutic index, and positively impacting clinical success probabilities of the new agents. ADMET assessment, usually integrated through biological/in silico models, allows for early detection of liabilities associated with synthetic oxadiazole analogues and the resultant optimization (Mishra *et al*., 2020) [9]. Adopting this approach with the development of ADMET biological assessment integrates efficiently within the drug discovery process and results in a reduced likelihood of eventual eschewal due to suboptimal ADMET.

Challenges and Future Perspectives

Oxadiazole derivatives, which are increasingly useful in medicinal chemistry and drug design, still face limitations that hinder their successful application as therapeutics. One of the challenges in their synthesis is achieving isomer selectivity and the introduction of functional groups that are often complex and can lead to difficult reaction conditions or require unusual reagents. Another challenge in their synthesis is the desire for lead compound optimization where biological activity has to be balanced with the desired physicochemical properties, such as solubility or metabolic stability. This optimization can be a resource-heavy and unpredictable process (Atmaram & Roopan, 2022) [2]. Even after successful *in vitro* results, off-target effects, unclear toxicity, and insufficient understanding of long-term effects in humans still impede *in vivo* use and clinical success. Although their privileged position as heterocycles cannot be disputed, further methodological development and translational research studies are necessary to allow the advancement of oxadiazole derivatives from the set of established compounds amenable to synthetization to the class of clinically approved drugs (Atmaram & Roopan, 2022) [2].

As a prospective, research development on oxadiazole derivatives should focus on the novel synthetic process that can overcome the existing problem regarding regioselectivity and functional group variation. Moreover, there are more efficient and scalable synthetic process development efforts, such as catalyst-mediated or flow synthesis that can accelerate the synthetic analogue of complex derivative and biological testing. A broader biological testing effort with high-throughput assay technology support and computational technology can discover novel therapeutic targets and unexplored pharmacological profiles of oxadiazole derivatives (Mishra *et al*., 2020) [9]. Emergence of drug discovery technologies integration, such as artificial intelligence and machine learning can advance lead optimization process, off-target interactions prediction, and rational drug design. The integration of this strategies will prepare the oxadiazole compounds development in a more promising route from preclinical study to clinical trial and to become an innovative formulation in pharmaceutical applications and industries (Mishra *et al*., 2020) [9].

Conclusion

The development of oxadiazole derivatives for synthesis and evaluation has seen significant progress, with the establishment of such compounds as a performing tool in both medicinal chemistry and drug development. The use of novel synthetic methods combined with targeted functionalization approaches has allowed the emergence of diverse oxadiazole scaffolds with chemical and biological properties that are fine-tuned. Their potential for a wide range of diseases has been demonstrated with extensive pharmacological testing and ADMET profiling, including the most difficult targets for infectious and oncology diseases. The advances in DC and biological screening have allowed an improvement in the selection and development of candidates based on oxadiazole derivatives, which positional as a versatile molecular platform. Overcoming the remaining synthetic and pharmacological obstacles to their use, emerging research is likely to propel the further contribution of oxadiazole derivatives to future clinical development.

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