Available online on 15.10.2023 at http://jddtonline.info

Journal of Drug Delivery and Therapeutics

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Review Article

A Review Exploring Therapeutic Effect of 1,3,4-Oxadiazole Compounds

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Article Info:

Article History:

Received 17 July 2023
Reviewed 04 Sep 2023
Accepted 22 Sep 2023
Published 15 Oct 2023

Cite this article as:

Kurup SS, Jat RK, A Review Exploring Therapeutic Effect of 1,3,4-Oxadiazole Compounds, Journal of Drug Delivery and Therapeutics. 2023; 13(10):147-148

DOI: http://dx.doi.org/10.22270/jddt.v13i10.5979

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Abstract

There are many synthesized compounds that contain the five-membered aromatic ring 1,3,4-oxadiazole. It is advantageous for 1,3,4-oxadiazole derivatives to have effective binding with various enzymes and receptors in biological systems through numerous weak interactions, eliciting a variety of bioactivities. This is made possible by the peculiar structural feature of the 1,3,4-oxadiazole ring with pyridine type of nitrogen atom. For scientists, research on the creation of derivatives based on 1,3,4-oxadiazole has become an intriguing subject. Numerous 1,3,4-oxadiazole-based compounds with strong therapeutic potencies are widely utilized to treat a variety of illnesses, which has a significant positive impact on development. In the entire spectrum of medicinal chemistry, including anticancer, antifungal, antibacterial, antitubercular, anti-inflammatory, antineuropathic, antihypertensive, antihistaminic, antiparasitic, antiobesity, antiviral, and other therapeutic agents, this work provides a systematic and thorough review. It is anticipated that this evaluation will be very beneficial for fresh ideas in the search for logical designs for the creation of more effective and less harmful 1,3,4-oxadiazole-based pharmaceutical medicines.

Keywords: 1,3,4-oxadiazole; anticancer; antimicrobial; antioxidant; isoforms; therapeutic worth.

Introduction

Chemistry studies have always been fascinated by the study of heterocyclic molecules. Heteroatoms like nitrogen, oxygen, and sulfur can be found in the rings in place of carbon. The heterocyclic medicines get increased potency and a wider range of functionalization through substitutions. Important heterocyclic compounds with therapeutic applications include those found in the vitamin B complex, colors, enzymes, antibiotics, alkaloids, amino acids, and medications. The diverse beneficial biological effects of heterocyclic compounds are mostly caused by the presence of the five-membered oxadiazole nucleus. Oxadiazole, with the general formula C2H2ON2, is produced when two methine (-CH=) groups that were previously present in the furan ring are replaced by two pyridine type nitrogen (-N=) groups. This somewhat reduces the aromaticity of the ring, oxadiazole, so that they now reflect the characteristics of a conjugated diene. Due to the low density of electrons on the carbon atom in oxadiazole, any electron-releasing group added to it will result in the electron withdrawing effect of pyridine-type nitrogen, making electrophilic substitution processes impossible.It is found that the oxadiazole ring resists nucleophilic replacements.

The oxadiazole 1,2,4, 1,2,5, and 1,3,4 are all known compounds, but the 1,2,3 isomer is very unstable and reverts to the diazoketone tautomer. Many medicinal products, including raltegravir, fasiplon, butalamine, oxolamine, pleconaril, and nesapidil, include stable oxadiazoles. Due to its extensive spectrum of actions, including its antibacterial, anti-inflammatory, anti-fungal, antitubercular, anticonvulsant, anthelmintic, herbicidal, antioxidant, analgesic, anti-tumor, and anti-hepatitis B viral properties, oxadiazole has taken a special place in the field of medicinal chemistry.

Biological Activities:

New anti-microbial, anti-inflammatory, analgesic, anticancer, anti-convulsant, anthelmintic, herbicidal, antimycobacterial, and anti-oxidant compounds are crucial and difficult to produce for medicinal chemists.

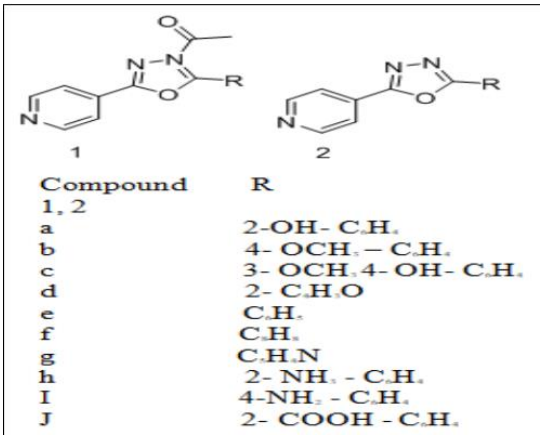
For the creation of new medications, there are two main methods:

(a) synthesis of analogs and their modifications, as well as derivatization, which results in novel substituted compounds for better and improved treatment, and

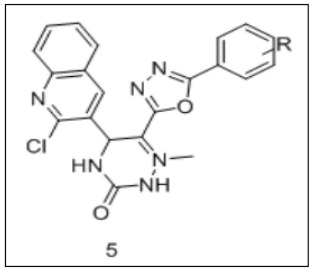
(b) searching for and synthesis of novel compounds, which have never been seen before in bacteria or diseases. Substituted 1, 3, and 4-oxadiazoles are widely known, patented, and effective antibacterial, anti-inflammatory, analgesic, anti-tumor, and anti-convulsant compounds for this use.

1, 3, 4 oxadiazole's biological effects include analgesic and anti-inflammatory effects. The new 1, 3, 4-oxadiazole with mercapto substitution exhibits good anti-inflammatory action, and if supplementary amines are added to this scaffold, the activity improves [1].

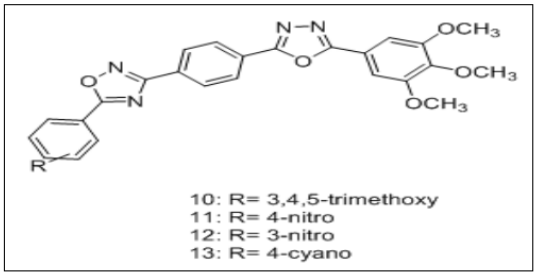
Dhansay Dewangan et al., (2010) synthesized 2, 5- di substituted 1, 3, 4-Oxadiazole derivatives 1 and 2, newly synthesized compounds were investigated for their analgesic activity by Acetic acid-induced writhing method using Swiss albino mice (25-35g) and anti-inflammatory activity by carrageenan induced rat paw edema and were determined according to mercury displacement method by using plethysmograph on adult albino rats (150- 180g). So compound 1b, 2f and 2j were shown significant analgesic activity, whereas compound 1c, 2g and 2j were shows good anti-inflammatory activity [2] .



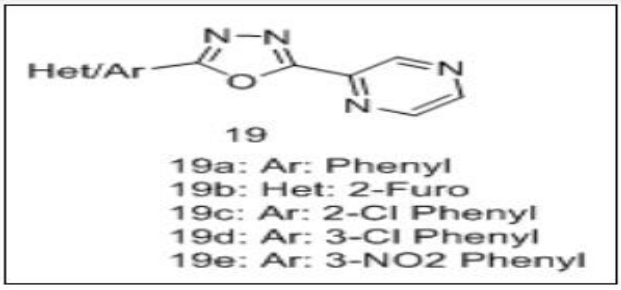
Antimicrobial Activity: Researches on 1, 3, 4- oxadiazole and their derivatives have shown that they have very prominent anti-microbial activity against a wide range of microbes. Godhani et al., (2019) synthesized a series of dihydropyrimidine substituted 1, 3, 4-oxadiazole derivatives by cyclization of carbohydrazide using phosphoryl chloride and benzoic acid in acidic condition. Every compound was primary assessed for their in-vitro antimicrobial activities against five bacterial strains viz. [Staphylococcus aureus (MRSA; ATCC 43300), Klebsiella pneumoniae (ATCC 700603), Escherichia coli (ATCC 25922), Acinetobacter baumannii (ATCC 19606), Pseudomonas aeruginosa (ATCC 27853)] and two fungi Strains viz. [Candida albicans (ATCC 90028), Cryptococcus neoformans var. grubii (H99; ATCC 208821)] [3].



Anti-cancer Activity: Polothi and his research team members in the year (2019) designed and synthesized new hybrids containing the 1, 3, 4- oxadiazole with 1,2,4- oxadiazolering systems. The synthesized compounds were confirmed by 1H NMR, 13CNMR and mass spectroscopic techniques [4] .



Antitubercular Activity: Armakovic and coworkers (2018) reported molecules containing 1, 3, 4-oxadiazole moiety attached to a pyrazine ring. The molecule with unsubstituted phenyl ring (19a) and the one with furan ring (19b) displayed activity of 1.6 µg/ml, while the most active molecules of the series, 19c, 19d and 19e displayed inhibitory activity of 0.8 µg/ml, which was 4 times more active than the reference, pyrazinamide[5].



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