An overview of oxadiazole-containing compounds as potential antidiabetic agents

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Abstract---1,3,4-oxadiazole and 1,2,4-oxadiazole derivatives are amongst the family of heterocycles which showed many promising
pharmaceutical applications. Extensive literature survey of 1,3,4-oxadiazole scaffold revealed the activities such as antimicrobial, anti-inflammatory, anti-tubercular, anti-oxidant, anti-cancer, anti-convulsant, anti-diabetic and analgesic properties. 1,2,4-oxadiazole, have shown activity against a variety of diseases like Alzheimer’s, parasitic worms (helminths) and other internal parasites, edema, infectious diseases, diabetes, pain and cramp, cardiovascular disease, HIV, tuberculosis, antioxidant, cancer, seizure disorders, and arthritis. As oxadiazoles exhibited many different types of pharmacological activities, we reviewed its pharmacological activities reported by different researchers in the field. In present article we reviewed different articles which has been published in English literature. The search engine used to search for the articles were Scopus, Google scholar, Bentham science, Science direct, Taylor and Francis, Springer nature, Frontiers, and Hindawi. Oxadiazole patent applications have grown by 100% in the previous 9 years, reaching a total of 646, making this a highly sought-after compound in the scientific community (Pace & Pierro, 2009). Several oxadiazole-containing compounds are now in late-stage clinical trials in drug research and development, including zibotentan (1) as an anticancer agent and ataluren (2) as a cystic fibrosis therapy (Fig. 2)(A. M. Jones & Helm, 2009). Raltegravir (3), an antiretroviral medication for the treatment of HIV infection, is the only oxadiazole-containing molecule currently on the market (Summa et al., 2008). More and more drug development initiatives in many different disease areas are taking use of oxadiazoles, including diabetes (R. M. Jones et al., 2009), obesity (Suk et al., 2008), inflammation (Unangst et al., 1992), cancer (Zhang et al., 2005), and infection (Cottrell et al., 2004).

**Keywords**---1,3,4-oxadiazole, 1,2,4-oxadiazole, DPP-IV, diabetes mellitus, antidiabetic agents.

**Introduction**

In both the medical and industrial arenas, compounds with heterocyclic ring structures are very important. Polymer and material science researchers have shown interest in the properties of oxadiazole, which have five-membered rings with two carbon, two nitrogen, and one oxygen carbon atoms (Fig. 1). Oxadiazole patent applications have grown by 100% in the previous 9 years, reaching a total of 646, making this a highly sought-after compound in the scientific community (Pace & Pierro, 2009). Several oxadiazole-containing compounds are now in late-stage clinical trials in drug research and development, including zibotentan (1) as an anticancer agent and ataluren (2) as a cystic fibrosis therapy (Fig. 2)(A. M. Jones & Helm, 2009). Raltegravir (3), an antiretroviral medication for the treatment of HIV infection, is the only oxadiazole-containing molecule currently on the market (Summa et al., 2008). More and more drug development initiatives in many different disease areas are taking use of oxadiazoles, including diabetes (R. M. Jones et al., 2009), obesity (Suk et al., 2008), inflammation (Unangst et al., 1992), cancer (Zhang et al., 2005), and infection (Cottrell et al., 2004).
Drug development initiatives have used oxadiazole rings in a variety of ways. When included in the pharmacophore, they have been shown to enhance ligand binding in several ways. Another use for oxadiazole moieties is as a flat, aromatic linker to put substituents in the correct orientation and to modulate molecular characteristics by situating them on the molecule's perimeter. Aldose reductase active site water architecture may be altered by utilising two structurally similar oxadiazole regioisomers, which have recently been demonstrated to have important thermodynamic features. Oxadiazoles have also been utilised to substitute carbonyl-containing molecules such esters, amides, carbamates and hydrogenated hydroxamic esters (Ohmoto et al., 2001; Ono et al., 2008; Orlek et al., 1991).

Two 1,2,4-isomers, one 1,3,4-isomer and one 1,2,5-isomer are possible regioisomers of oxadiazole rings (Figure 1). Side chains R1 and R2 of the 1,2,5-regioisomer are oriented differently from the other three isomers, making this isomer less frequent. Oxadiazoles with different regioisomeric configurations all have identical R1 and R2 side chains, resulting in similar locations for these side chains. Matching pairs are anticipated to have the same overall molecular structures and hence bond in the same way. Oxadiazoles have fascinating hydrogen bond acceptor capabilities, and it will be demonstrated that the regioisomers have dramatically varied hydrocarbon bonding potentials (Boström et al., 2006; Ladbury et al., 2010; McBriar et al., 2008). As oxadiazoles exhibited many different types of pharmacological activities, we reviewed its pharmacological activities reported by different researchers in the field.
Method

In present article we reviewed different articles which has been published in English literature. The search engine used to search for the articles were Scopus, Google scholar, Bentham science, Science direct, Tayler and Francis, Springer nature, Frontiers, and Hindawi.

Review of Oxadiazole derivatives as potential Antidiabetic Agents

1,3,4-oxadiazole and 1,2,4-oxadiazole derivatives are amongst the family of heterocycles which showed many promising pharmaceutical applications. Extensive literature survey of 1,3,4-oxadiazole scaffold revealed the activities such as antimicrobial, anti-inflammatory, anti-tubercular, anti-oxidant, anti-cancer, anti-convulsant, anti-diabetic and analgesic properties(Asif & Abida, 2020; Bajaj et al., 2015; Sun et al., 2013; Zheng et al., 2020). 1,2,4-oxadiazole, have shown activity against a variety of diseases like Alzheimer’s, parasitic worms (helminths) and other internal parasites, edema, infectious diseases, diabetes, pain and cramp, cardiovascular disease, HIV, tuberculosis, antioxidant, cancer, seizure disorders, and arthritis(Arshad et al., 2014; Nazari et al., 2021; Pitasse-Santos et al., 2018; Shukla & Srivastava, 2015; Sonawane et al., 2017; Zhu et al., 2020).

Omarigliptin (MK-3102) is a sulfonamide containing moiety, which produces its anti-hyperglycaemic action by inhibiting the DPP-IV enzyme(Stoimenis et al., 2017). Its pharmacokinetic studies have shown that it is suitable for once-a-week dosing, which makes it unique among the other DPP-IV inhibitors. 2-Cyanopyrrolidine derivatives belong to glycine-based inhibitors, of main class peptidomimetic inhibitors(Dalgaard et al., 2016; Kato et al., 2011). 2-Cyanopyrrolidine derivatives which shows the presence of nitrile group on the five-membered pyrrolidine ring that provides reversible nanomolar inhibition of the DPP-IV enzyme(Srivastava et al., 2015). In the present work we are aiming to discover a new oxadiazole derivatives which can possess potential antidiabetic activity. We assumed that molecules-based on oxadiazole could provide an alternative treatment of diabetes that not only manages glycemic levels but also prevents the development of arteriosclerosis and other diabetes problems.

Kumar S. et al. have reported some 2-((benzothiazol-2-ylthio) methyl)-5-phenyl-1, 3, 4-oxadiazole derivatives as potential antidiabetic agents. All the synthesized compounds were tested for in vivo antidiabetic potential by taking Glibenclamide as standard. All the molecules have demonstrated significant activity but 6f [4-{5-(((6-methylbenzo[d]thiazol-2-ylthio)methyl)-1,3,4-oxadiazol-2-yl)aniline, Fig. 3] displayed prominent activity at 350 mg/kg p.o.(Kumar et al., 2016).

Figure 3. The potent antidiabetic oxadiazole derivative reported by Sunil Kumar et al.
Bhutani R. et al. had synthesized a series of new benzothiazole-1,3,4-oxadiazole-4-thiazolidinone hybrid analogs (Tz1-Tz28) in search for potential anti-diabetic agents. Molecular docking study was conducted with binding pocket of peroxisome proliferator activated receptor-gamma to elucidate the binding interactions of newly synthesized targets. Seven selected compounds with best docking scores were further screened for in vivo anti-hyperglycemic efficacy by oral glucose tolerance test in non-diabetic rats and on streptozotocin-induced diabetic rat models. All the tested compounds demonstrated excellent to moderate reduction in blood glucose levels. Three of the compounds (Tz21, Tz7 and Tz10) showed excellent anti-diabetic effect by reducing concentration of glucose to 157.15 ± 1.79 mg/dL, 154.39 ± 1.71 mg/dL, 167.36 ± 2.45 mg/dL, respectively better than the standard drug, pioglitazone, 178.32 ± 1.88 mg/dL. Moreover, three derivatives Tz21, Tz4 and Tz24 (Fig. 4) with IC$_{50}$ values of 0.21 ± 0.01 µM, 9.03 ± 0.12 µM and 11.96 ± 0.40 µM respectively also showed better inhibitory activities on alpha-glucosidase even more than the standard acarbose (IC$_{50}$ = 18.5 ± 0.20 µM), indicating Tz21 has the highest inhibitory effect among the seven tested derivatives. Prediction of Drug like properties using molinspiration online software suggests that all the synthesized compounds have potential of becoming the orally active molecules. Thus, these novel hybrids could serve as potential candidates to become leads for the development of new drugs eliciting anti-hyperglycemic effect orally(Bhutani et al., 2019).

Figure 4. Benzothiazole-1,3,4-oxadiazole-4-thiazolidinone hybrid analogs as antidiabetic agents reported by Bhutani R. et al.

Ramesh S. Gani et al. have synthesized and evaluated novel 5-(2,5-bis(2,2,2-trifluoroethoxy)phenyl)-1,3,4-oxadiazole-2-thiol derivatives (2a-2i) for in vitro and in vivo biological activity. The compounds 2a-2i demonstrated α-amylase inhibitory activity in the range of IC$_{50}$ = 40.00–80.00 µg/ml as compare to standard acarbose (IC$_{50}$ = 34.71 µg/ml). Compounds 2a-2i demonstrated α-glucosidase inhibitory activity in the range of IC$_{50}$ = 46.01–81.65 µg/ml as compared to standard acarbose (IC$_{50}$ = 34.72 µg/ml). Docking studies on a target
protein, N-terminal subunit of human Maltase-glucoamylase (PDB:2QMJ) was carried and the compounds were found to dock into the active site of the enzyme. The predicted binding energies of the compounds were calculated. The in vitro studies indicate that compounds 2b and 2g had better activity among the synthesized compounds. Whereas in vivo study indicates that 2b, 2g, and 2i could lower glucose levels in the Drosophila, but then 17–30% reduced capacity than acarbose and may be overcome by adjusting their dosage. The in vitro and in vivo studies indicate that compounds 2b and 2g had better activity among the synthesized compounds. This study has recognized that compounds like 2b, 2g, and 2i (Fig. 5) may be considered potential candidates for further developing a novel class of antidiabetic agents (Gani et al., 2021).

Figure 5. Novel 5-(2,5-bis(2,2,2-trifluoroethoxy)phenyl)-1,3,4-oxadiazole-2-thiol derivatives as potential antidiabetic agents reported by Ramesh S. Gani et al.

Rubina Bhutani et al. have prepared a small library of new benzothiazole clubbed oxadiazole-Mannich bases (M-1 to M-22) were synthesized and characterized by IR, NMR, Mass and Elemental analysis results. Molecular docking studies were done to assess the binding mode and interactions of synthesized hits at binding site of receptor Peroxisome proliferator-activated receptor, PPAR-γ or PPARG (PDB 1FM9). Among the synthesized compounds, nine compounds were selected on the basis of docking score and evaluated for their in vivo anti-diabetic activity using Oral Glucose Tolerance Test (OGTT) in normal rats followed by Streptozotocin (STZ)-induced diabetes. Results indicated that compound M-14 (161.39 ± 4.38) (Fig. 6) showed the highest reduction of blood glucose level comparable to that of the standard drug glibenclamide (140.29 ± 1.24) in STZ model. Other compounds exhibited moderate to good anti hyperglycaemic activity. ADME studies was done using Molinspiration online software, revealed that all compounds (except M-11) are likely to be orally active as they obeyed Lipinski's rule of five (Bhutani et al., 2018).
Sonja Nordhoff et al. had reported a series of β-homophenylalanine based inhibitors of dipeptidyl peptidase-IV ADME properties were improved by the incorporation of amide replacements. These efforts led to a novel series of potent and selective inhibitors of DPP-IV that exhibit an attractive pharmacokinetic profile and show excellent efficacy in an animal model of diabetes. Representatives 6m and 7f (Fig. 7) of this novel chemical series exhibit attractive pharmacokinetic profiles and show excellent efficacy in an animal model of diabetes (Nordhoff et al., 2009).

Jinyou Xu et al. have reported a novel series of potent, selective, and orally bioavailable DPP-4 inhibitors. These are among the most potent compounds reported to date lacking an electrophilic trap. The optimized compound 43 (Fig. 8) exhibited excellent selectivity over a variety of DPP-4 homologs. However, further development of this compound was not pursued due to the short half-life observed upon oral administration in both rats and dogs (Xu et al., 2006).
Muhammad Iftikhar et al. had synthesized a series of new N-aryl/aralkyl derivatives of 2-methyl-2-{5-(4-chlorophenyl)-1,3,4-oxadiazole-2-thiol}acetamide by successive conversions of 4-chlorobenzoic acid into ethyl 4-chlorobenzoate, 4-chlorobenzoylhydrazide and 5-(4-chlorophenyl)-1,3,4-oxadiazole-2-thiol, respectively. The required array of compounds (6a-n) was obtained by the reaction of 1,3,4-oxadiazole with various electrophiles (5a-n) in the presence of DMF (N,N-dimethylformamide) and sodium hydroxide at room temperature. The structural determination of these compounds was done by infrared, $^1$H-NMR (nuclear magnetic resonance), $^{13}$C-NMR, electron ionization mass spectrometry, and high-resolution electron ionization mass spectrometry analyses. All compounds were evaluated for their α-glucosidase inhibitory potential. Compounds 6a, 6c-e, 6g, and 6i (Fig. 9) were found to be promising inhibitors of α-glucosidase with IC$_{50}$ values of 81.72 ± 1.18, 52.73 ± 1.16, 62.62 ± 1.15, 56.34 ± 1.17, 86.35 ± 1.17, 52.63 ± 1.16 µM, respectively. Molecular modeling and ADME (absorption, distribution, metabolism, excretion) predictions supported the findings. The current synthesized library of compounds was achieved by utilizing very common raw materials in such a way that the synthesized compounds may prove to be promising drug leads (Iftikhar et al., 2019).

Figure 8. A potent oxadiazole derivative reported by Jinyou Xu et al.

Figure 9. 1,3,4-oxadiazole derivatives with potent α-glucosidase inhibitory potential reported by Muhammad Iftikhar et al.
Madiha Kazmi et al. have reported three series of diamine-bridged bis-coumarinyl oxadiazole conjugates were designed and synthesized by one-pot multicomponent methodology. The synthesized conjugates (4a-j, 5a-j, 6a-j) were evaluated as potential inhibitors of glucosidases. Compound 6f containing 4,4'-oxydianiline linker was identified as the lead and selective inhibitor of α-glucosidase enzyme with an IC$_{50}$ value of 0.07 ± 0.001 μM (acarbose: IC$_{50}$ = 38.2 ± 0.12 μM). This inhibition efficacy was ~545-fold higher compared to the standard drug. Compound 6f (Fig. 10) was also emerged as the lead molecule against intestinal maltase-glucoamylase with good inhibition strength (IC$_{50}$ = 0.04 ± 0.02 μM) compared to acarbose (IC$_{50}$ = 0.06 ± 0.01 μM). Against β-glucosidase enzyme, compound 6g was noted as the lead inhibitor with IC$_{50}$ value of 0.08 ± 0.002 μM. Michaelis-Menten kinetic experiments were performed to explore the mechanism of inhibition. Molecular docking studies of the synthesized library of hybrid structures against glucosidase enzyme were performed to describe ligand-protein interactions at molecular level that provided an insight into the biological properties of the analyzed compounds. The results suggested that the inhibitors could be stabilized in the active site through the formation of multiple interactions with catalytic residues in a cooperative fashion. In addition, strong binding interactions of the compounds with the amino acid residues were effective for the successful identification of α-glucosidase inhibitors(Kazmi et al., 2018).

![Figure 10. Diamine-bridged coumarinyl oxadiazole conjugates as antidiabetic agents reported by Madiha Kazmi et al.](image_url)

Muhammad Taha et al. had synthesized twenty derivatives of 5-aryl-2-(6'-nitrobenzofuran-2'-yl)-1,3,4-oxadiazoles (1-20) and evaluated for their α-glucosidase inhibitory activities. Compounds containing hydroxyl and halogens (1-6, and 8-18, Fig. 11) were found to be five to seventy folds more active with IC$_{50}$ values in the range of 12.75±0.10-162.05±1.65μM, in comparison with the standard drug, acarbose (IC$_{50}$=856.45±5.60μM). Current study explores the α-glucosidase inhibition of a hybrid class of compounds of oxadiazole and benzofurans. These findings may invite researchers to work in the area of treatment of hyperglycemia. Docking studies showed that most compounds are interacting with important amino acids Glu 276, Asp 214 and Phe 177 through hydrogen bonds and arene-arene interaction(Taha et al., 2016).
Hayat Ullah et al. reported 1,3,4-Oxadiazole derivatives as antidiabetic agents. The synthetic derivatives were screened for α-glucosidase inhibitory potential. All compounds exhibited good inhibitory activity with IC₅₀ values ranging between 0.80 ± 0.1 to 45.1 ± 1.7 μM in comparison with the standard acarbose having IC₅₀ value 38.45 ± 0.80 μM. Thirteen compounds 1-6 and 8-14 showed potential inhibitory activity as compared to the standard acarbose having IC₅₀ value 38.45 ± 0.80 μM, however, only one compound 7 (IC₅₀ = 45.1 ± 1.7 μM) was found to be less active. Compound 14 (IC₅₀ = 0.80 ± 0.1 μM) showed promising inhibitory activity among all synthetic derivatives. Molecular docking studies were also conducted for the active compounds to understand the ligand-enzyme binding interactions (Ullah et al., 2019).

Muhammad Taha et al. had reported oxindole based oxadiazoles hybrid analogs (Fig. 12) as potential α-glucosidase inhibitors. All compounds were found potent inhibitors for the enzyme with IC₅₀ values ranging between 1.25 ± 0.05 and 268.36 ± 4.22 μM when compared with the standard drug acarbose having IC₅₀ value 895.09 ± 2.04 μM. The present study identifies novel series of potent α-glucosidase inhibitors and further investigation on this may lead to the lead compounds. A structure activity relationship has been established for all compounds. The interactions of the active compounds and enzyme active site were established with the help of molecular docking studies (Taha et al., 2018).

Jinyou Xu et al. had published US patent entitled, “1,2,4-Oxadiazole derivatives as dipeptidyl peptidase-IV inhibitors for the treatment or prevention of diabetes”. The present invention is directed to novel 1,2,4-oxadiazole derivatives (Fig. 13) which are inhibitors of the dipeptidyl peptidase-IV enzyme (“DP-IV inhibitors”)
and which are useful in the treatment or prevention of diseases in which the dipeptidyl peptidase-IV enzyme is involved, such as diabetes and particularly type 2 diabetes. The invention is also directed to pharmaceutical compositions comprising these compounds and the use of these compounds and compositions in the prevention or treatment of such diseases in which the DPP-IV enzyme is involved (Xu et al., 2008).

Figure 13. 1,2,4-Oxadiazole derivatives as dipeptidyl peptidase-IV inhibitors

Syeda Shamila Hamdani et al. has reported the synthesis, X-ray diffraction, density functional theory (DFT) and α-amylase inhibition activities of three 1,3,4-oxadiazole derivatives (1–3). The compounds are synthesized in good yields (70–83%) and their structures are confirmed through different spectro-analytical techniques and single crystal X-ray diffraction. Density functional theory (DFT) calculations are performed to validate not only X-ray results, but also to investigate the dispersion of charges and reactivity through frontier molecular orbitals and molecular electrostatic potential (MEP) analyses. α-amylase inhibition assay is performed in order to find out the enzyme inhibitory potential of the synthesized compounds (1–3, Fig. 14). The low IC50 value (86.83 ± 0.23 μg/mL) of compound 2 reflects the potential α-amylase inhibitory activity of the compound as compared to others (Hamdani et al., 2020).

Figure 14. Three 1,3,4-oxadiazole derivatives as α-amylase inhibitors reported by Syeda Shamila Hamdani et al.

Muhammad Tukur Ibrahim et al. had reported an in-silico study to investigate the anti-diabetic activities of 27 Oxadiazoles derivatives. The anti-diabetic compounds were optimized using Density Functional Theory (DFT) method utilizing B3LYP version with 6-31G* basis set. Genetic Function Algorithm (GFA) was used to
build four models. Model 1 was chosen as the best model, assessed and found to be statistically significant with \( \text{LOF} = 0.030552, \ R^2 = 0.9681, \ R^2_{\text{adj}} = 0.9567, \ Q^2_{\text{CV}} = 0.9364 \) and \( R^2_{\text{pred}} = 0.6969 \). The results of the molecular docking studies revealed that ligand 10, 13 and 15 have the highest docking scores of \(-9.9\, \text{kcal/mol}\) among the co-ligands. This study has shown that the docking scores generated were in good agreement with the work reported by other researchers. The results of this study give room for designing new anti-diabetic compounds with better inhibitory activity against \( \alpha \)-glucosidase, an enzyme that catalyzes the hydrolysis of carbohydrate to produce excess glucose.

Majid Nazir et al. had studies the sequential conversion of indolyl butanoic acid into ethyl indolyl butanoate, indolyl butanohydrazide, and 1,3,4-oxadiazole-2-thiol analogs by adopting chemical transformations. In a parallel series of reactions, 2-bromo-N-phenyl/arylacetamides (7a-l) were synthesized by reacting different amines derivatives (5a-l) with 2-bromoacetyl bromide to serve as electrophile. Then, the synthesized electrophiles (7a-l) were treated with nucleophilic 1,3,4-oxadiazole-2-thiol analog to afford a range of N-substituted derivatives (8a-l, Fig. 15). The structural confirmation of all the synthetic compounds was carried out by IR, 1H-, 13C NMR, EI-MS, and CHN analysis data. All synthesized molecules (8a-l) were tested for their antidiabetic potential via inhibition of the \( \alpha \)-glucosidase enzyme followed by their in silico study. Their cytotoxicity profile was also ascertained via hemolytic activity and all of them possessed very low cytotoxicity. Compounds 8h and 8l were found most active having \( \text{IC}_{50} \) values \( 9.46 \pm 0.03 \, \mu M \) and \( 9.37 \pm 0.03 \, \mu M \), respectively. However, all other molecules also exhibited good to moderate inhibition potential with \( \text{IC}_{50} \) values between \( 12.68 \pm 0.04 - 37.82 \pm 0.07 \), compared to standard acarbose (\( \text{IC}_{50} = 37.38 \pm 0.12 \, \mu M \)), hence can be used as lead molecules for further research in order to get better antidiabetic agents(Nazir et al., 2018).

![Figure 15. The oxadiazole derivatives reported by Majid Nazir et al.](image)

**Conclusion**

The heterocyclic family that includes 1,3,4-oxadiazole and 1,2,4-oxadiazole derivatives is one that has been shown to have several potential uses in the healthcare industry. We investigated the pharmacological activities of oxadiazoles as they were reported by a variety of researchers working in the same area. Oxadiazoles were found to display a wide variety of pharmacological activities. The number of patent applications for oxadiazole has increased to a total of 646 in the last nine years, representing a growth of 100 percent during that time period. This indicates that the scientific community places a high value on this molecule. As a result of our analysis, we came to the conclusion that oxadiazoles are sufficiently powerful to warrant further investigation into their use as possible
antidiabetic medicines, more specifically as DPP-IV inhibitors. We feel that the researchers who are striving to create some novel Oxadiazole derivatives as prospective antidiabetic drugs may benefit from this review by gaining some new insights as a result of reading it.

Conflicts of Interests

Authors declared that there is no conflicts of interests exists.

References


α-amylase inhibition of three novel 1,3,4-oxadiazole derivatives. *Journal of Molecular Structure, 1200.* https://doi.org/10.1016/j.molstruc.2019.127085


