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IMPORTANCE OF FURAN BASED COMPOUNDS AND THEIR BIOMEDICAL APPLICATIONS: AN OVERVIEW

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ABSTRACT

Furan based substituted compounds showed very promising biomaterials such as antimicrobial, anti cancer, antihyperglucemic and analgesic. The poly substituted compounds are employed as building blocks of synthesis of naturally occurring biomaterials which are important in medicinal chemistry. Some of the Benzo furan substituted compounds placed role in asthma, rheumatism and ulcers, Immune nanoparticle of furan based polymeric nanoparticle of biodegradable graft co-polymer to provide a reactive functional group for coupling chemistry of antibodies through Diels-Alder chemistry. Here we enlighten the importance of furan compounds in biomedical application through provoke new findings in this area of research.

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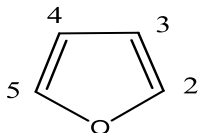
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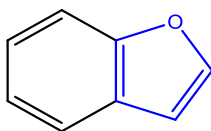
INTRODUCTION

Furan is one of the heterocyclic compounds; the name furan comes from the Latin *furfur*, which means bran. The simplest member of furan family is furan itself, a colourless, volatile and somewhat toxic liquid that boils at 31.36°C (88.45°F).

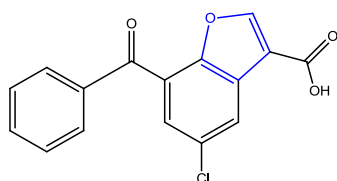
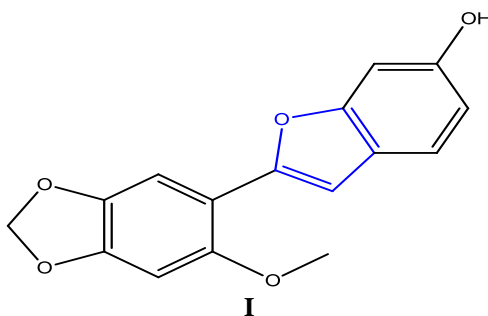


The first furan compound discovered was pyromicic acid (2-furoic acid), prepared in 1780[1]. It can be found as a component in a number of significant biologically active natural products [2-5] such as pinguisone, furodysinin and methyl vouacapente[6-9]. Polysubstituted furans can also be employed as building blocks for the synthesis of naturally occurring metabolites and various substituted furans used as pharmaceutical agents such as flavour and fragrance compounds, insecticides, anti-leukemic drug. Furan-related compounds have been reported to possess antihyperglucemic, analgesic, anti-inflammatory, antibacterial, antifungal, antitumor activities[10].

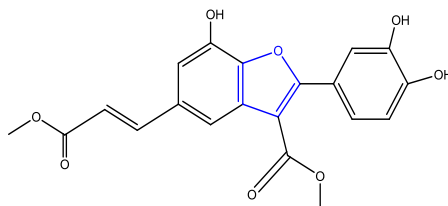
Importance of substituted Furans: Benzofuran



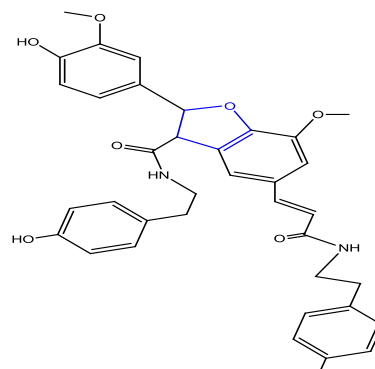
Benzo-furan, often found naturally occurring heterocyclic, plays an important role in both drug discovery and chemical biology. Many approved therapies derived from natural sources show a wide range of pharmacological activities [11, 12]. The first naturally occurring hydroxylated benzofuran, cicerfuran (I), was found in the roots of a wild species of chickpea, *Cicer bijugum*, and reported to be a major factor in the defence system against *Fusarium wilt*.



II



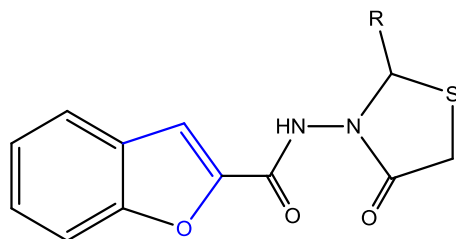
III



IV

These benzofurans are widely rooted in synthetic and biologically interesting compounds that act as analgesics (e.g. BRL 37959, II) and as potential anti-cancer agents (III and IV). Substituted benzofurans find application as anti-oxidants, brightening agents and in a variety of fields of chemistry, agriculture and also used in the treatment of asthma, rheumatism and ulcers [13-18].

Thiazolidinones based benzofuran are the derivatives of thiazolidine which belong to an important class of heterocyclic compounds containing sulphur and nitrogen in a five membered ring with carbonyl group is known to be important, since it gives derivatives of different biological activities, like antimicrobial and anti mitotic assay [19]

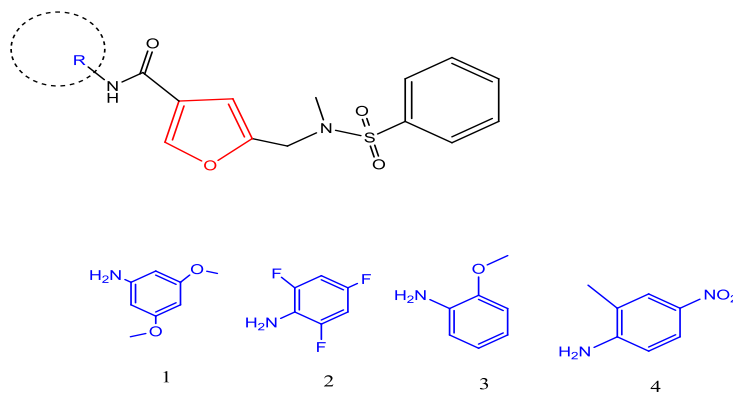


Sl.No	R	activity
1		Anti fungal & Anti microbial
2		
3		
4		
5		
6		

Among above compounds the compound (2) showed good activity compared with rest of the compounds.

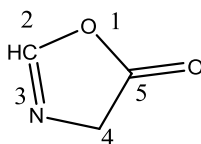
Ddisubstituted furan

The 2,4 disubstituted furan compounds which gave significant biological activity in anti diabetic activity [20-25] Babu S.P and Suresh Babu K.synthesized synthesised some 2,4 substituted compounds below in 2012 such as 5-[(Benzenesulfonyl-methyl-amino)-methyl]-furan-3-carboxylic acid (3,5-dimethoxy-phenyl)-amide(1),5-[(Benzenesulfonyl-methyl-amino)-methyl]-furan-3-carboxylic acid (2,4,6- trifluoro-phenyl)-amide (2), 5-[(Benzenesulfonyl-methyl-amino)-methyl]-furan-3-carboxylic acid (2-methoxy-phenyl)-amide (3), 5-[(Benzenesulfonyl-methyl-amino)-methyl]-furan-3-carboxylicacid (2-methyl-4-nitro-phenyl)-amide (4).



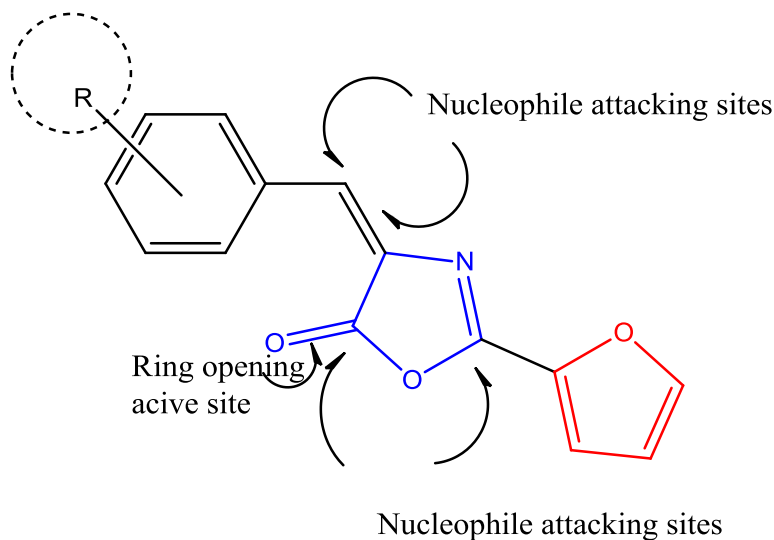
Furan based Oxazolone

Oxazolone play a important role in the manufacturing various biologically active drugs such as analgesic, anti-inflammatory, antidepressant, anti-cancer, anti-microbial, anti-diabetic and anti obesity[26-27].it involves the intramolecular Diels-Alder reaction in the production of cancer drug, pancratistatin, a phenanthrealkaloid, Deflazacort [28]. Oxazolone ring which inhibit proliferation of several human and marine cancer cell lines [29].



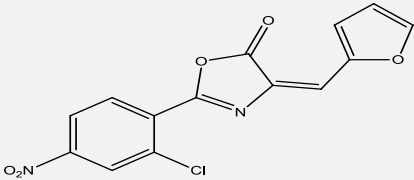
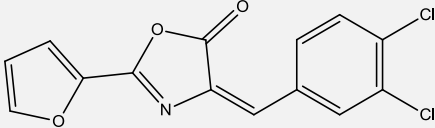
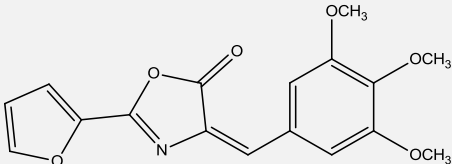
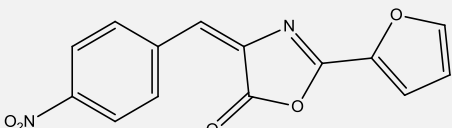
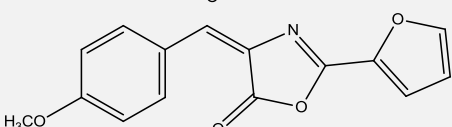
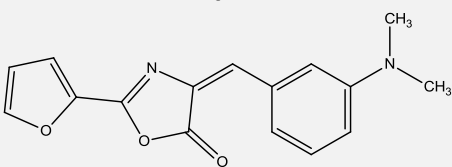
Chemistry

Affecting charge of the carbon C-2



Substitution at C-4 and C-2 position plays a vital role in the activity and influenced immunosuppressive activity [30].functional groups at C-4 and C-2 position plays tyrosine's inhibitory activity. Conjugation through double bond at C-4, by functional group and C-2 position of phenyl ring for the above structure plays a vital role in the activity [31]. The ring opening is decreased by increase of the electron donating groups of phenyl substituent [32]. Lewis acid activation of carbonyl group of unsaturated oxazolones gives electrophilic character to the β carbon [33], nucleophile attack the carbonyl group leading to a ring opening. Exocyclic double bond can operate as dienophile and Substituted oxazolone participates in intermolecular Diels-Alder reactions [34]

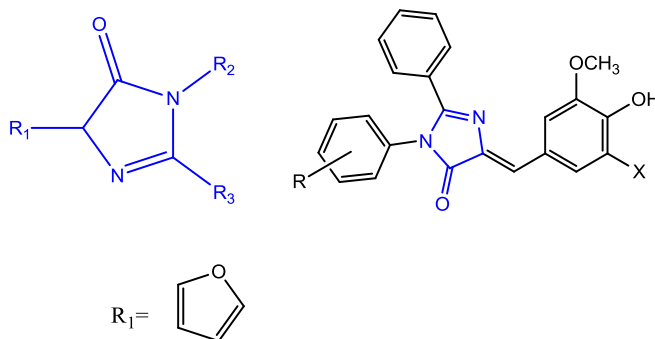
Some of the important compounds which contain oxazolones, involves in various biological activates are given below.

Sl. No.	compound	Name	activity	Reference
1		2-(2-chloro-4-nitrophenyl)-4-(furan-2-ylmethylene)oxazole-5(4H)-one	Antimicrobial	14
2		4(3,4dichlorobenzylidene)-2-(furan-2-yl)oxazol-5(4H)-one	hypoglycemic activity, anti-inflammatory	23
3		2-(furan-2-yl)-4-(3,4,5-trimethoxybenzylidene)oxazol-5(4H)-one	hypoglycemic activity, anti-inflammatory	23
4		2-(furan-2-yl)-4-(4-nitrobenzylidene)oxazol-5(4H)-one	hypoglycemic activity, anti-inflammatory	23
5		2-(furan-2-yl)-4-(4-methoxybenzylidene)oxazol-5(4H)-one	hypoglycemic activity, anti-inflammatory	23
6		4-(3-(dimethylamino)benzylidene)-2-(furan-2-yl)oxazol-5(4H)-one	antidepressant	23

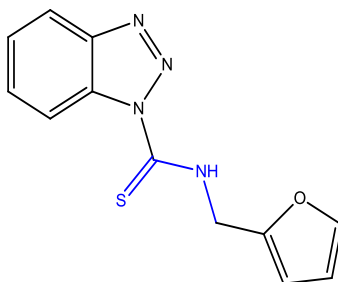
Some of the compounds which contain furan as basic skeleton are possess cardiovascular activities, slight change in substitution pattern in furan nucleus caused distinguishable difference in biological activities. An iodinated lipophilic furan derivative is used in the treatment of ventricular and atrial fibrillation.

Furan based imidazolone, thioamide derivatives

Imidazolone compounds have been found to be associated with their various biological activities such as potassium channel opener, Phosphodiesterase III/IV inhibition and crop protection[35-39] Among imidazolones, 2-aminoimidazolone containing the guanidine moiety is particularly an attractive scaffold due to its hydrogen bonding donor and acceptor abilities in the active sites of various proteins and exhibit various biological activities[40-41] like inhibitors HCMV protease, Chymotrypsin and human leukocyte elastase as well as cell assay results for antiviral activity[42-43].



R	Molecular formula	Activity
4-I	$C_{23}H_{16}N_2O_3I_2$	Antimicrobial activity
4-NO ₂	$C_{23}H_{16}N_3O_5I$	
4-I	$C_{23}H_{16}N_2O_3IBr$	
4-OCH ₃	$C_{24}H_{19}N_2O_4Br$	
4-OCH ₃	$C_{24}H_{19}N_2O_4I$	

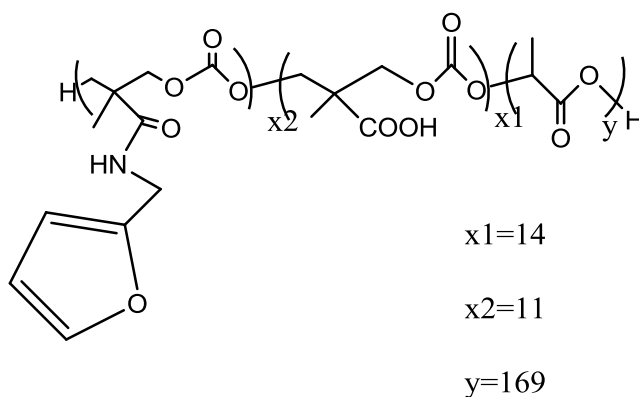


N-(furan-2-ylmethyl)-1*H*-benzo[*d*][1,2,3]triazole-1-carbothioamide

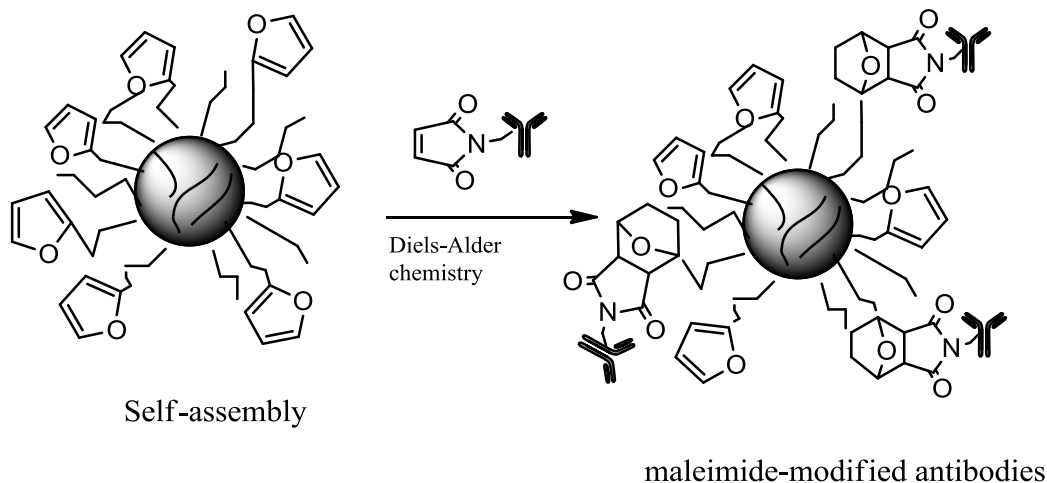
Thioamide compound derivatives was first synthesized by Katritzky A.R.et al., in 2004 further research were found in 2012 by Golzar Hossain G.M.et al., for their importance of biological activities like antimicrobial, antioxidant assay..Based on this finding we decided to synthesize new furan based imidazolone derivatives and thiomide derivatives to expecting that offer different chemical or biological activities [44-45].

Furan based polymeric derivatives

Furan based polymers such as A-B-A, B-A-A type polymeric nanoparticles (poly(TMCC-*co*-LA)-*g*-PEG-furan and poly(TMCC-*co*-LA)-*g*-furan) undergoes Diels –Alder chemistry which plays very important role in Bio molecule conjugation and it is widely acceptable.



Technique for Immobilization of Peptides/proteins on a substrate for the development for biosensors and medical materials [46].This is efficient conjugation chemistries which are applicable to a broad class of bio molecules [47].



Immune nanoparticle were prepared by polymeric nanoparticle using biodegradable graft co-polymer for provide reactive functional group for coupling chemistry of antibodies [48]. These compounds showed good potency as anti cancer agents.

CONCLUSION

Furan based substituted compounds, especially polymeric immune nanoparticles giving promising enormous activity in biomedical applications and due to their small size and providing by reactive functional group to coupling chemistry of antibodies. This has given new window to synthesise new furan immune based compounds to the biomedical applications.

Authors's contributions

Dakshayini and devaraju designed this paper

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Competing interests

The authors declare that they have no competing interests

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