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Biological Potentials of Biological Active Triazole Derivatives: A Short Review

Mohammad Asif*

Department of Pharmacy, Guru Ram Das Institute of Management and Technology, Dehradun, Uttarakhand, India

Abstract

Triazole is a versatile lead molecule for designing potential bioactive agents. The triazole derivatives have been found to exhibit diverse biological activities such as anti-fungal, antibacterial, antitubercular, anti-inflammatory, analgesic, anticancer, antiviral and other biological properties. Consequently, they have attracted increasing attention in the field of drug discovery. Similarly, oxazoles and their fused heterocyclic derivatives have received considerable attention owing to their effective medicinal importance.

Keywords: Heterocycles; Triazole; Oxazole; Biological activities

Introduction

Heterocycles make up an exceedingly important class of compounds. In fact, more than half of all known organic compounds are heterocycles. Many natural drugs are heterocyclic in nature. Many synthetic drugs are also heterocycles. Heterocyclic compounds occupy a central position among those molecules that make life possible. Heterocycles have been explored for developing pharmaceutically important molecules. In recent decades there has been constant interest in the chemistry of azoles because more than hundred azole derivatives are used today as drugs. Azoles are heterocyclic compounds characterized by a five-membered ring which contains an atom of nitrogen and at least one other non-carbon atom, nitrogen, sulfur or oxygen. These compounds are aromatic and have two double bonds.

Triazoles and related compounds

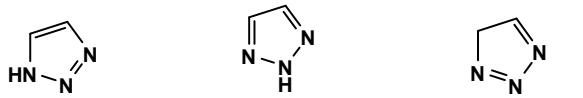
Five inembered aromatic rings with three nitrogen atoms are called triazoles. The two possible combinations of the five atoms account for vicinal(v) and syrnmetrical(s) triazoles In chemical absracts, v-triazoles is also listed as 1H-l,2,3-t-riazoie or pyrrodiazole and 2H-l,2,3-triazole or pyrrodiazole. The pyrrodiazole was occasionally used to designate triazole. The term osotriazole refers to derivatives of 2H-1,2,3-triazole particularly those prepared from osazones (Schemes 1 and 2).

Heterocyclic compounds bearing a symmetrical triazoles moiety have been reported to have a broad spectrum of pharmacological activities (Schemes 3-9).

Triazoles have been reported to possess wide variety of biological activity. Some of these activities are mentioned here.

Anti-inflammatory activity: Anti-intlammatory activity of some new 2,5-di-substituted 1,3,4-oxadiazoIe derivative (**1**) [1]. The presence of n-butyl amino group at 2nd position of 1,3,4-oxadiazole nucleus **la** showed maximum activity, where as the presence of cyclohexyi amino group **lb** showed minimum activity (Scheme 10).

1a R=$CH_3CH_2CH_2CH_2$

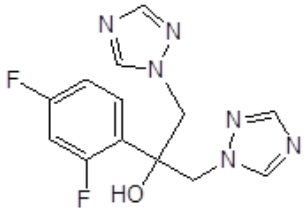


(a) IH 1,2,3 triazole **(b)** 2H 1,2,3 triazole **(c)** 1,2,3 -isotriazole

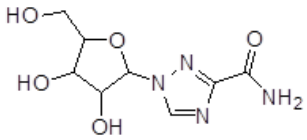
Scheme 1: V-Triazole or 1,23 Triazole.

(a) IH-1,2,4 traizole **(b)** 4H-1,2,4 triazole **(c)** 1,2,4 isotriazole **(d)** 1,3,4 triazole

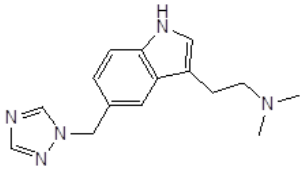
Scheme 2: S -Triazole or 152,4-Triazole.



Scheme 3: Fluconazole (Anti-fungal agent).



Scheme 4: Ribavirin (Antiviral agent).



Scheme 5: Rizatriptan (Anti-inflammatory Agent).

***Corresponding author:** Mohammad Asif, Department of Pharmacy, Guru Ram Das (Post Graduate) Institute of Management and Technology, Dehradun-248 009, Uttarakhand, India, Tel: 01352734327; E-mail: aasif321@gmail.com

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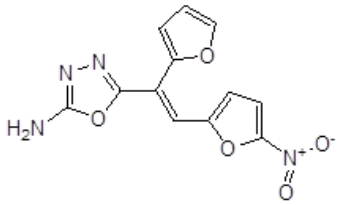
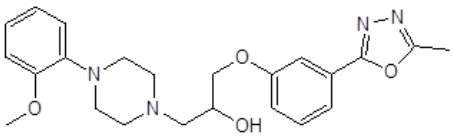
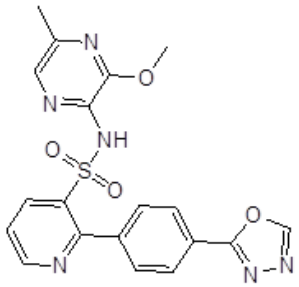


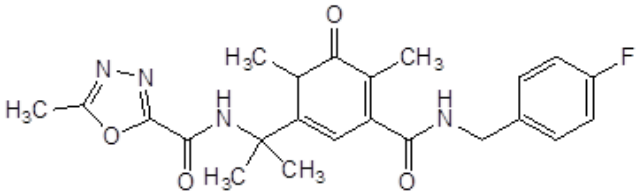
Scheme 6: Furamizole (Anti-bacterial agent).



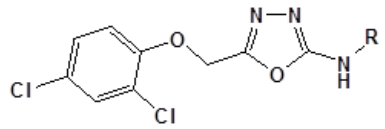
Scheme 7: Nesapidil (Anti-arrhythmic agent).



Scheme 8: Zibotentan (Anticancer agent).



Scheme 9: Raltegravir (Antiretroviral drug - Treatment of HIV infection).



Scheme 10: Anti-intlammatory activity of some new 2,5-di-substituted 1,3,4-oxadiazole derivative.

1b R= C_6H_{11}

1c R=p-Cl-C_6H_4

1d R=p-F-C_6H_4,

1e R=p-CH_3-C_6H_4

In vitro inhibition of cyclooxygenase and 5-lipooxygenase activities of 1,3,4-oxadiazole derivatives (2) [2] (Scheme 11).

2b R=2,6-di-Ci, 3-CH_3

2b R=3-CF_3

2b R=2,3-$(CH_3)_2$

These compounds are dual inhibitors of cyclooxygenase and 5-Lox. Among these **2c** is more active (80%) than **2a** and **2b**.

The inflammatory, analgesic and antihypertensive properties of 3,6-diaryl-l,2,4 triazoies[3,4-a] phthalazines (**3a** and **3b**) [3] (Scheme 12).

3a=R = C_6H_5- R_1=H, p-OCH_3, 3,4-dimethoxy, p-CH_3, o –NO_2,

3b=R =p- $CH_3C_6H_4$, R_1= H, p-OCH_3, 3,4 - dimethoxy, p-CH_3, o-NO_2

Compounds of **3a** series exhibited promising antiflammatory activity (40, 51 and 52%) compared to phenylbutazone at a dose of 100 mg/kg body wt. These compounds also showed mild to moderate analgene activity (4-40%) in comparison to aspirin (60%) at 100 mg/kg body wt. Some of these compounds at a dose of mg/kg, -i.v also produced rapid fall in blood pressure followed by quick recovery whereas hydrakizine at 2 mg/kg i.v. produced gradual and transient fail in the blood pressure (42 mm Hg) with long duration and slow recovery.

Anti-inflamatory activity of 3-(substituted phenyl)4'(substituted phenyl) 5-(aIkyl/alkenyl-rnercapto)-l H-1,2,4 triazoies (**4a-h**) [4] (Scheme 13).

4a R=Cl R_1 =H R_2=CH_3

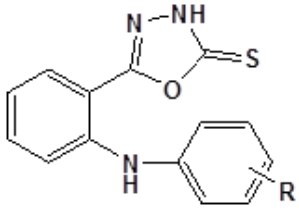
4b R=Cl R_1 =H R_2=C_2H_3

4c R=Cl R_1 =H R_2=CH_2CH=CH_2

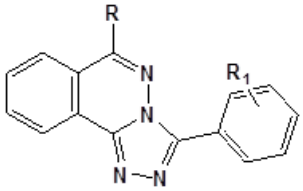
4d R=OH R_1 =H CH=CH_2CH_3

4e R=OH R_1 =p-Br R_2=C_2H_5

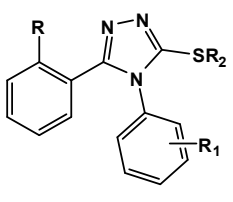
4f R=OH R_1 =p-Br R_2=CH_2CH=CH_2



Scheme 11: *Invitro* inhibition of cyclooxygenase and 5-lipooxygenase activities of 1,3,4-oxadiazole derivatives (2).



Scheme 12: 3,6-diaryl-l,2,4 triazoies[3,4-a] phthalazines.



Scheme 13: Anti-inflamatory activity of 3-(substituted phenyl)4'(substituted phenyl(alkyl/alkenyl-rnercapto)-l H-1,2,4 triazoies.

4g R=OH R_1 =o-CHi R_2=CH_3

4h R=OH R_1 =o-CH, R_2=$CH_2CH_2CH_3$

Significant anti-inflammatory activity was observed in compounds, which contain halogen group in any of the phenyl ring at position 4 and allyl or propyl group at position 5 (compound **4c** and **4f**). Compound **4f** showed maximum inhibition of 47% in comparison to other compounds.

Anti-inflammatory acitivity of 3-[2{(phenyl/methyl)benzylidene) aminojoxy] methyl/ethyl-4-amino-5-mercapto-l,2,4-triazole (**5a-d**) [5] (Scheme 14).

5a R_1= C_6H_5 R_2= C_6H_5

5b R_1=CH_3 R_2=C_6H_5

5c R_1= C_6H_5 R_2= CH_3

5d R_1=CH_3 R_2= C_6H_5

All the compounds exhibited significant anti-inflammatory activity in comparison to ibuprofen at 50mg/kg body wt.

Antibacterial activity: The antibacterial activity of pyrazole and 1,3,4-oxadiazole derivatives of 2-phenyl-1,8- napthyridine (**6,7**) [6] (Scheme 15).

6a Ar=C_6H_5

6b Ar=p-$CH_3C_6H_4$

6c P-$CH_3OC_6H_4$

6d Ar=p-ClC_6H_4,

6e Ar=p-BrC_6H_4

6f Ar=o-HOC_6H_4

6g Ar= 2,4 -$(HO)_2C_6H_3$

6h Ar=m- NO_2-C_6H_4

6i Ar=p-$NO_2C_6H_4$

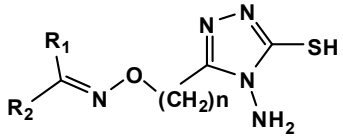
6J Ar=2-Napthyl

7a Ar=C_6H_5

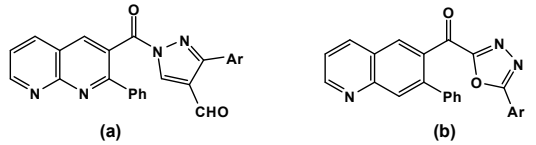
7b Ar=p-$CH_3C_6H_4$

7c P-$CH_3OC_6H_4$

7d Ar=p-ClC_6H_4,



Scheme 14: Methyl/ethyl-4-amino-5-mercapto-l,2,4-triazole.



Scheme 15: The antibacterial activity of pyrazole and 1,3,4-oxadiazole derivatives of 2-phenyl-1,8- napthyridine (**a, b**) [6].

7e Ar=p-BrC_6H_4

7f Ar=o-HOC_6H_4

7g Ar= 2,4 -$(HO)_2C_6H_3$

7h Ar=m- NO_2-C_6H_4

7i Ar=p-$NO_2C_6H_4$

7J Ar=2-Napthyl

Compounds **6b**, **6c**, **6d**, **6b**, **7d** and **7e** were most effective while **6h**, **6i**, **7a**, **7g** and **7h** were found to have low activity. The remaining conipounds were moderate activity. Antibacterial activity of 1, 3, 4-oxadiazoles (**8**) [7] (Scheme 16).

R_1= $C_6H_5XCH_2$

R_2= C_6H_5, H, NH_2

8a X=S R_1=Ph

8b X=SO_2 R_1= Ph

8c X=S, R_1=H-

8d S O_2 R_1=H

Antibacterial activity of these compounds against *E. coli* and *B. Cirroflagellous* are decreases in the order like 8a>Sb>8c>8d. Antibacterial activity of coumarin incorporated 1,3,4-oxadiazoles (**9a-d**) [8] (Scheme 17).

9a R_1= CH_3 R_2 =C_6H_5

9b R_1= CH_3 R_2=P-OH-C_6H4

9c R_1= CH_3 R_2=p-CH_3C6H_4

9d R_1= CH_3 R_2 =p-$OCH_3C_6H_4$

All the compounds were screened for their antibacterial activity against *E. coli* and *Staphylcoccus* using ciprofloxacin as std. drug. The compound **9d** showed 80% inhibition against *S. aureus* while, **9a** showed 80% inhibition against *E. coli.* The 3-aryloxy methyl/pheny! ethyl-4-phenyl-5-(-(5'inercapto-4'-phenyl-1,2,4 thiazol-3'-yl-methyI mercapto)-l,2,4triazoles (**l0a-c**) for evaluating antibacterial activity [9] (Scheme 18).

10a R_1=2-CH_3 R_2=5-CH_3

10b R_1=4-CH_3, R_2=5-CH_3

10c R_1=H R_2=H

All these compounds exhibited promising antibacterial activity against *E. coli* and *S. aureus.* Antibacterial activity of 4-(psubstituted phenyl)-3-niercapto-5-[2'-morphoiino)quinoxalinol-l,2,4triazoles (**lla-c**) at a concentration of 2, 3 and 5 mg/ml, against *S. aureus, S. typhi, E. coli* and *B. subnlis* [10] (Scheme 19).

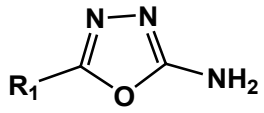
11a, R = p-chlorophenyl

11b, R = p-methoxy phenyl

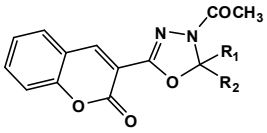
11c, R = phenyl

Compound **l1b** was found to inhibit all the test organisms whereas **11a** was totally inactive against all the organisms. A series of substituted 2-(5'-inercapto-4'-phenyl-1',2', 4'-triazole-3'-yl)indoles (**12a-k**) [11] (Scheme 20).

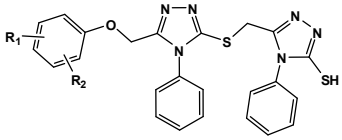
12a R_1=Cl R_2=H R_3= H



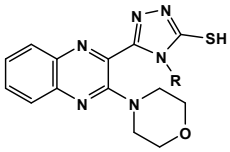
Scheme 16: Antibacterial activity of 1, 3, 4-oxadiazoles.



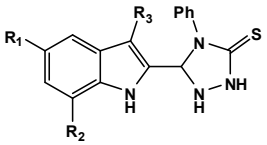
Scheme 17: Antibacterial activity of coumarin incorporated 1,3,4-oxadiazoles.



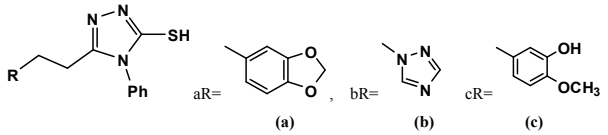
Scheme 18: Ethyl-4-phenyl-5-(5'inercapto-4'-phenyl-1,2,4 thiazol-3'-yl-methyl mercapto)-l,2,4triazoles.



Scheme 19: Antibacterial activity of 4-(psubstituted phenyl)-3-niercapto-5-[2'-morphoiino)quinoxalinol-l,2,4triazoles.



Scheme 20: Substituted 2-(5'-inercapto-4'-phenyl-1',2', 4'-triazole-3'-yl) indoles (12a-k).



Scheme 21: Antibacterial activity of 3-(-aryl ethyl)-4-phenyl-5-mercapto-l, 2,4, triazoies (**13a-c**) [12].

12b R_1= Cl R_2=H R_3=CH_3

12c R_1=Cl R_2=H R_3= Ph

12d R_1=Cl R_2=H R_3=Br

12e R_1=OCH3 R_2= H R_3=H

12f R_1=CH3 R_2=H R_3= CH_3

12g R_1=OC_2H_5 R_2=H R_3=H

12h R_1=CH_3 R_2=Br R_3=H

12i R_1=Br R_2=H R_3= H

12j R_1=Br R_2=H R_3=Ph

12k R_1=$CH_3$$R_2$=H$R_3$=$CH_3$

All these compounds were found to possess significant against *E. coli, S. aureus* and antifungal activity against *C. utilis* and *S. cerevisiae.* Antibacterial activity of 3-(-aryl ethyl)-4-phenyI-5-mercapto-l, 2,4, triazoies (**13a-c**) [12] (Scheme 21).

All these compounds were active against *S. aureus, E. coli, S. typhi,* and *P. aeruginosa* except **13b**, which was inactive against *Pseudmonas.*

Anticonvulsant activity: Anticonvulsant activity of some new 1,3,4-oxadiazoie derivatives (**14**) [13]. Anticonvulsant activity of 2,4-dihydro-3H-1,2,4 triazol-3-ones (**15**) (Schemes 22 and 23).

15a Ar=C_6H_5 R_1=H R_2= H

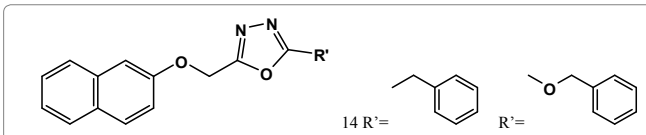
15b Ar=$C_6H_5R_1$=CH_3 R_2=H

15c Ar=$C_6H_5R_1$=H R_2=CH_3

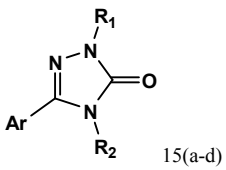
15d Ar=$C_6H_5R_1$=H R_2=C_2H_5

The anticonvulsant activities of the triazoles were tested against maximal electroshock and pentylene tetrazole-induced seizures in mice. The compounds having monohalogenated aryl substituents were found to be most active.

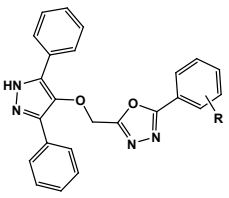
Antifungal activity: Most of the recent clinically used anti-fungal drugs contain triazoie nucleus, none of the drug used today are from other azoles like oxadiazole, pyrazine, and triazine. The main drawback of triiizoles is CYP_{450} Isoform inhibition selectivity. This results in many drug interactions when given concomitantly with certain medications also metabolized by this CYP Isoform. For example, fluconazole inhibits the metabolism of warfarin leading to increase in bleeding time. Fluconazole also decrease the metabolism of the CYP_{2C9} substrate phenytoin, an anti-epileptic drug with a narrow therapeutic index. On the basis of above facts, different types of azoles are still in progress to get a better drug, some are given as follows. Antifungal activity of 2-aryl-5-(3,5-diphenylpyrazole4-yl oxymethyl)-1,3,4-oxadiazoles (**16a-c**) [14] (Scheme 24).



Scheme 22: Anticonvulsant activity of some new 1,3,4-oxadiazoie derivatives.



Scheme 23: Anticonvulsant activity of 2,4-dihydro-3H-1,2,4 triazol-3-ones.



Scheme 24: Antifungal activity of 2-aryl-5-(3,5-diphenylpyrazole4-yl oxymethyl)-1,3,4-oxadiazoles (**16a-c**).

Compound **16b** show promising antifungal activity against fungi as compared to **16a** and **16c**. Fungicidal activity of 3,6,9-triaryl-2-thioxothiazolo[4,5-d]-[l,3,4]oxadiazolo[2,3-b]pyrimidines (**17**) [15] (Scheme 25).

17a R=H R'= H

17b R=4-Cl R'=H

17c R=2-CH_3, R'=H

17d R=H R'=2-Cl

17e R= 4-Cl R'=2-Cl

17f R=2-CH, R'=2-Cl

I7g R=H R'=4-OCH_3

17h R=4-Cl R'=4-OCH_3

17i R=2-CH_3 R'=4-OCH_3

Compounds **17b**, **17e** and **17h** have very strong activity against *Aspergillus niger* and *Peuicilliiini cilrimun* at 1000, 100 and l0 ppm concentration. All these three compounds have either 2-Cl. 4-Cl or 4-OCH_3 groups (electron donar group) in their structure.

Thus, it can be concluded that Cl-group imparts much towards fungicidal activity of this series of compounds. Antifungal activity of oxadiazoles (**18**) [16], Good anticonvulsant activity is shown by 18b and 18c. Moderate activity produced by compound **18a** (Scheme 26).

Fungicidal activity of some 5-methylene-2-[5'-aryl-1',3'4'-oxadiazol-2'-yI]amino-4-thiazolones (**19**) against *A. niger* [17] (Scheme 27).

Among tested compounds **19a** is more active against *A. niger* then **19b** and **19c**. Activity is decreases on dilution to 100 and 10 ppm. The fungicidal activity of 2'-substituted spiro[indoline-3,5'-[5H][l,3,4]-oxadiazolo[3,2-C]-thiazol]-2-ones against *H. oryzae* (20) [18] (Scheme 28).

20a R=H

20b R= 2-CH_3

20c R=4-CH_3

20d R=3-CH_3

20e R=4-Cl, 3-CH_3

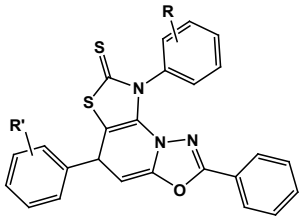
Among these compounds **20e** was the most active. It inhibited 90% growth of fungus. This compound has a -CH_3 group along with a chloro function on the phenyl ring which probably enhances fungitoxicily. Antifungal activity of 4-substituted-3,7-dimethyl-pyrazolo[3,4-e][l,2,4]triazine (**21**) [19] (Scheme 29).

The antifungal activity of tiie compounds was carried out by the poison food technique. Tiie compounds used were tested in potato dextrose broth in concentration of l0mg/ml, 5mg/ml, 2.5 mg/ml and 1 mg/ml. Compounds **21a** and **21d** are more active against fungus strain, because of presence of acidic group in these compounds. The fungitoxicity of 1,2,4-triazolo and thiadiazolo[3, 2-b]-l,3,4-oxadiazoles (**22, 23**) [20] (Scheme 30).

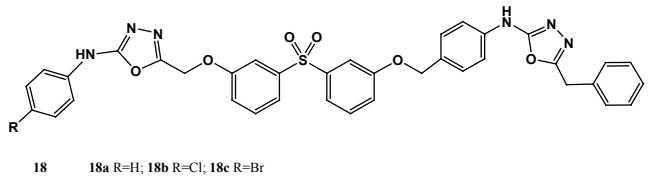
23a R=2-F R'=2-Cl; **23b** R=4-F R'=2-Cl; **23c** R=3-F R'=2-Cl

23d R=2-F R'=4-Cl; **23e** R=3-F R'=4-Cl; **23f** R=2-F R'=4-CH_3; **23g** R=4-F R'=4-CH_3; **23h** R=3-F R'=4-CH_3

Compound **22c**, **23a**, **23e** and **23g** showed full activity against fungus at l0ppm. The fungicidal data indicate that the presence of toxophoric group -Cl, -OCH_3 on phenyl ring enhances the activity. Antifungal activity of some 1,3,4-oxadiazoie derivatives (**24, 25**) [21] (Scheme 31).

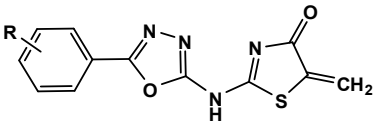


Scheme 25: Fungicidal activity of 3,6,9-triaryl-2-thioxothiazolo[4,5-d]-[l,3,4] oxadiazolo[2,3-b]pyrimidines (**17**).

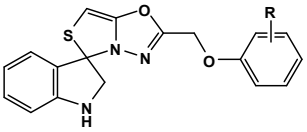


18 **18a** R=H; **18b** R=Cl; **18c** R=Br

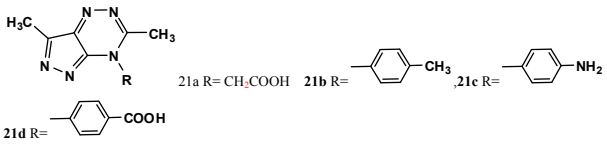
Scheme 26: Good anticonvulsant activity is shown by 18b and 18c.



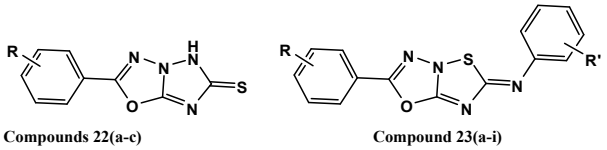
Scheme 27: Fungicidal activity of some 5-methylene-2-[5'-aryl-1',3'4'-oxadiazol-2'-yl]amino-4-thiazolones (**19**) against *A. niger*.



Scheme 28: The fungicidal activity of 2'-substituted spiro[indoline-3,5'-[5H][l,3,4]-oxadiazolo[3,2-C]-thiazol]-2-ones against *H. oryzae*.

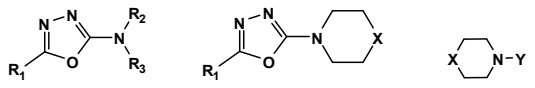


Scheme 29: Antifungal activity of 4-substituted-3,7-dimethyl-pyrazolo[3,4-e][l,2,4]triazine (**21**).



Compounds 22(a-c) **Compound 23(a-i)**

Scheme 30: The fungitoxicity of 1,2,4-triazolo and thiadiazolo[3, 2-b]-l,3,4-oxadiazoles (**22, 23**).



Scheme 31: Antifungal activity of some 1,3,4-oxadiazoie derivatives.

R_1=C_6H_5,

4-CI-C_6H_4,

4-$CH_3C_6H_4$,

4-$OCH_3C_6H_4$

R_2=R_3=CH_3.C_2H_5

R_2=H, R_3=C_6H_5

X=O, CH_2; Y=CH_2, $(CH_2)_2$

The maximal antifungal activity was observed with the compounds having dimethyl/ aniline/ morpholino/ piperidino moieties at the 2nd position of 1,3,4-oxadiazole. Antifungal activity of 5-substituted - I, 3, 4- oxadiazoline-2-thiones (26) [22] (Scheme 32). Among the compounds tested, compound (**26h**), carrying a morpholino methyl substituent possess highest degree of antifungal activity.

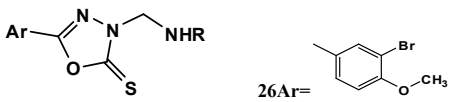
The antifungal activity of 5-arylidene-2-aryl-3-(1,2,4-triazoloacetamidyl)l,3-thiazol-4-ones (**27**). Compounds **27a**, **27b** and **27d** showed good antifungal activity (Table 1) [23] (Scheme 33).

The antifungal activity of 7/9-substituted-4-(3-alkyl/aryl-5,6-dihydro-s-triazoio[3,4-b]thia-diazol-6yl)-tetrazolo [1.5-a] quinolines (**28**) (Table 2) [24] (Scheme 34).

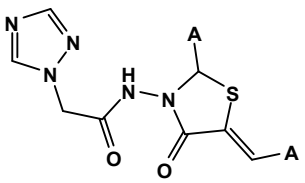
The compounds **28a** and **28c** showed significant antifungal activity against *A. niger* and *C. albicans* at 1000 g/ml concentrartion.

Compound	R
27a	o-Br-C_6H_4
27b	p-Br-C_6H_4
27c	o-CI-C_6H_4
27d	m-Br-C_6H_4

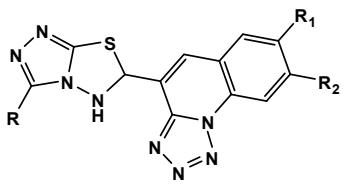
Table 1: The antifungal activiity of 5-arylidene-2-aryl-3-(1,2,4-triazoloacetamidyl) l,3-thiazol-4-ones (**27**). Compounds **27a**, **27b** and **27d** showed good antifungal activity.



Scheme 32: Antifungal activity of 5-substituted - I, 3, 4- oxadiazoline-2-thiones.



Scheme 33: Antifungal activiity of 5-arylidene-2-aryl-3-(1,2,4-triazoloacetamidyl) l,3-thiazol-4-ones (**27**).



Scheme 34: Antifungal activity of 7/9-substituted-4-(3-alkyl/aryl-5,6-dihydro-s-triazoio[3,4-b]thia-diazol-6yl)-tetrazolo [1.5-a] quinolines (**28**).

The fungicidal activity of 3-aryloxy/arylmethyI {-4-aryl-5-mercapto-1,2,4triazoles (**29a-f**) (Table 3) [25] (Scheme 35).

Against *A. niger* and *H. oiyzae* by agar plate technique at 1000, 100, 10 ppm concentration. The highest activity was shown by compounds having 3,4 dichlorophenyl moieties.

Some cyclic analogs of SM 8668, compound (**30**), these thiolene triazole derivatives had 4-chloro or 2,4-dichlorophenyl substituents (X=4C1 or 2,4Cl_2) instead of 2,4-difluorophenyl moiety of SM 8668 (Scheme 36).

30a, n = 1; X=2,4-Cl_2

30b, n = 1; X=4-CI

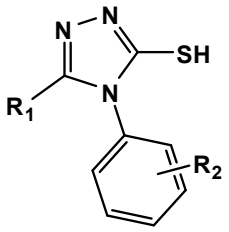
(30c), n =2; X=2,4 CI_2

These compounds were tested *in-vitro* and *in-vivo* antifungal activity, out of which **30a**, **30b**, and **30c** showed promising antifungal activity.

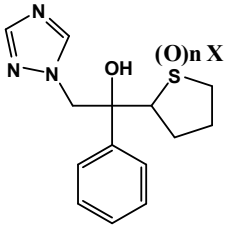
Antitubercular activity: Antituberculosis activity relationship study in a series of 5-(4-amino phenyl)-4-substituted-2,4-dihydro-3H-l,2,4-triazole-3-thiones, some of the compounds give moderate activity [26].

Anticancerous activity: The cytotoxic/antiproliferative effects of (1,2,4)-triazolo(4,3-c) quinazolines in tumor cell lines hela and B16. Some of the compounds produced moderate activity [27] (Figures 1-4).

Ravuconazole: It is found to be more potent thati flucofiazole and itraconazole aginst clinical isolates of *Crypiococciis deofonnans*.



Scheme 35: The fungicidal activity of 3-aryloxy/arylmethyl{-4-aryl-5-mercapto-1,2,4triazoles (**29a-f**).



Scheme 36: Thiolene triazole derivatives having 4-chloro or 2,4-dichlorophenyl substituents (X=4C1 or 2,4Cl_2).

Compound	R	R_1	R_2
28a	p-$OCH_3C_6H_4$	H	H
28b	C_3H_7	CH_3	H
28c	p-$OCH_3C_6H_4$	OCH_3	H
28d	o-$CH_3C_6H_4$	OCH_3	H

Table 2: The antifungal activity of 7/9-substituted-4-(3-alkyl/aryl-5,6-dihydro-s-triazoio[3,4-b]thia-diazol-6yl)-tetrazolo [1.5-a] quinolines.

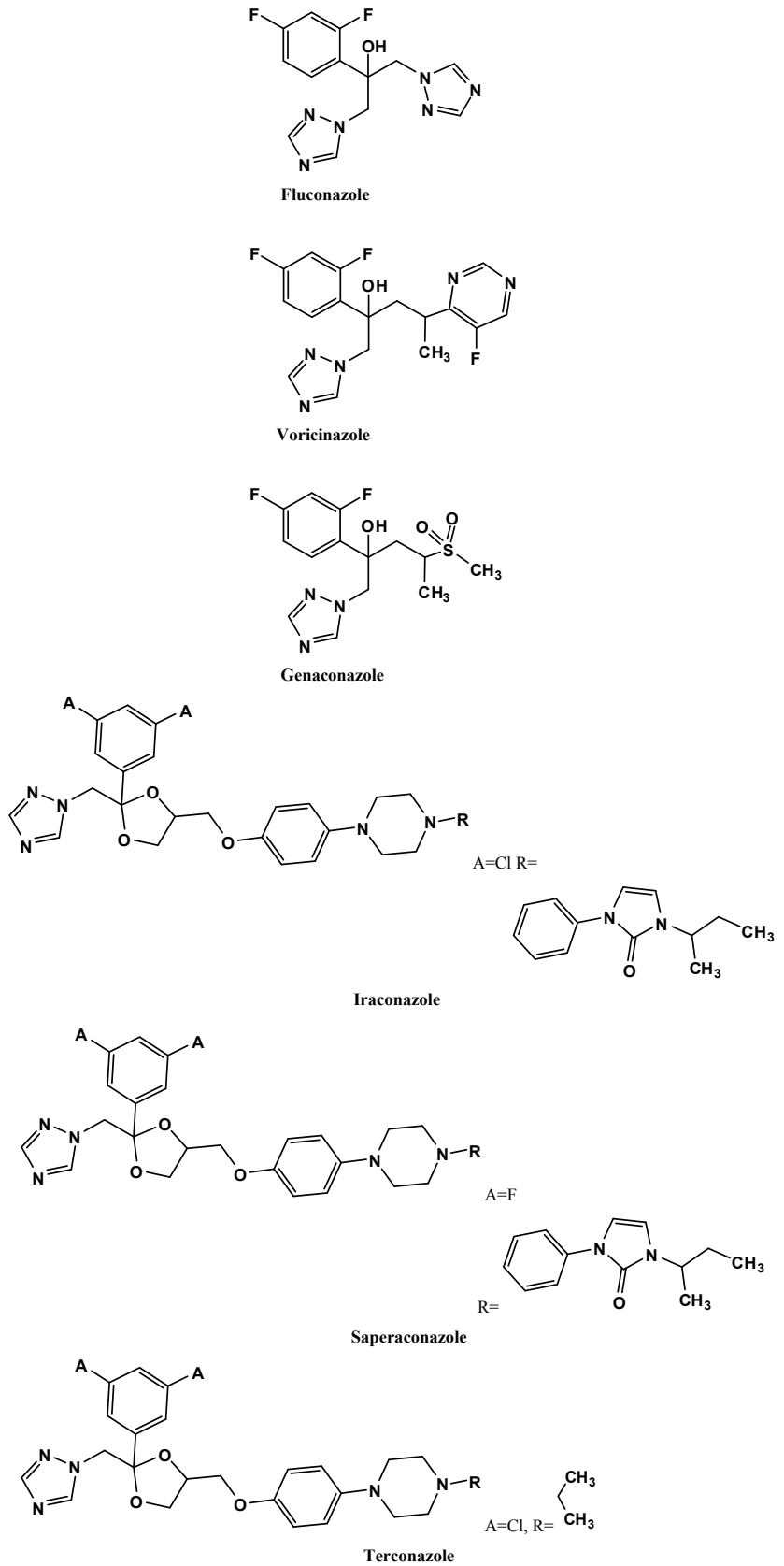
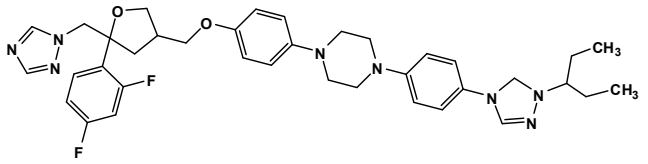


Figure 1: Antifungal drugs possessing azole nucleus.

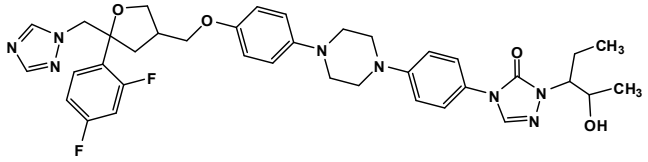


SCH-51048 26 [26]

Figure 2: Antifungal agents under clinical trial.

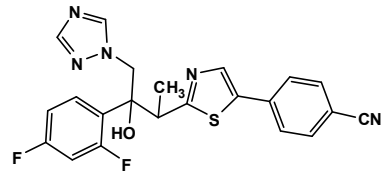
Compound	R_1	R_2
29a	p-Cl, 3-CH_3-$C_6H_3OCH_2$	2 -OCH_3
29b	p -Cl, 3-CH_3-$C_6H_3OCH_2$	3,4-Cl_2
29c	2,4-$(CH_3)_2$, C_6H_3-OCH_2	2-OCH_3
29d	2,4-$(CH_3)_2$, C_6H_3-OCH_2	3,4-Cl_2
29e	$C_6H_5CH_2$	3,4-Cl_2

Table 3: The compounds **28a** and **28c** showed significant antifungal activity against *A. niger* and *C. albicans* at 1000 g/ml concentration. The fungicidal activity of 3-aryloxy/arylmethyl {-4-aryl-5-mercapto-1,2,4triazoles.



SCH-56592 [27]

Figure 3: Orally acting triazole, which is completing phase-I clinical trials.



ER-30346 [28]

Figure 4: Wide spectrum orally acting antifungal agent.

Triazoles have been reported to possess wide variety of biological activity [28,29].

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