A REVIEW ON THE REPORTED ANTIBACTERIAL ACTIVITY OF 1,3,5-TRIAZINE

Abstract: Antibiotics are the class of drugs used for bacterial, viral & fungal infection. Antibiotic resistance is the ability of microorganism to withstand themselves against the effects of a drug. Every year antibiotic resistance causes more than 38000 deaths in Thailand, 23000 deaths in USA. In South Asia one new born child dies every 5 minutes from blood stream infection because antibiotics given are ineffective due to bacterial resistance. Now antibiotic resistance is a threat to global health. In this paper, triazene derivatives are kept in concern. Triazines are six-membered, nitrogen-containing heterocyclic scaffold with a wide range of pharmaceutical properties such as antibacterial, antifungal, anticancer, antioxidants, antitubercular, antimalarial and anti-inflammatory. Due to lack of new antibiotics as well older antibiotic are rapidly proving ineffective, derivatives of triazine would be of great significance in future prospective.

Keywords: Triazine, antibacterial, antifungal

1) INTRODUCTION:

Triazine is one of the most important lead molecules which are widely used in the field of pharmaceuticals. Triazine is the species of six membered heterocyclic structures having the empirical formula $C_3H_3N_3$ [1].Triazine structure is similar to the structure of benzene ring in which three nitrogen atoms replace three carbon atoms present in it. The different position of nitrogen atoms in the ring distinguish the three isomer of triazine and the isomers are referred as 1, 2, 3-triazine, 1, 2, 4-triazine and 1, 3, 5-triazine [2].

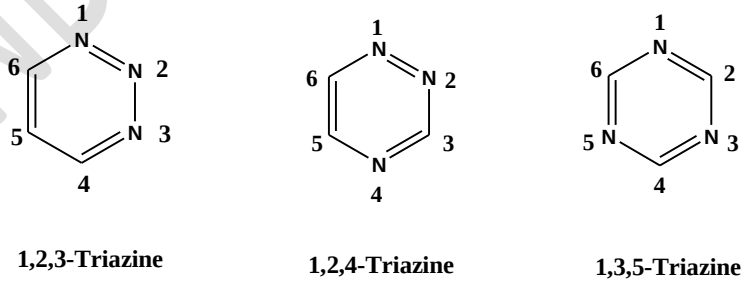


Fig.1.1: Various isomers of triazine.

Among all the isomers of triazine, 1, 3, 5-triazine isomer is the oldest known organic compound. 1, 3, 5-triazine sometimes also called as s-triazine because of the symmetry of three nitrogen atom in the ring [3]. Because of its broad applications in various fields like

pharmaceuticals, textiles, rubbers and plastic industries, 1.3.5-triazine considered as one of the well-known compound from long time. Substituted [1,3,5]-triazine derivatives have become an attractive targets in medicinal chemistry because of their significant biological activities such as antibacterial [4], antifungal [5]**,** antimalarial [6]**,** antitumoranti-inflammatory [7], antileishmanial[8]

Now a days, several studies have been carried out on the antibacterial activity of 1, 3, 5-triazines [9]. All 1, 3, 5-triazine derivatives that have a very wide practical applications consist of 2, 4, 6-mono, di ortri-substituted, symmetrical and non-symmetrical compounds having various kinds of substituent. The most important reagent among all of them for obtaining these synthetic molecule transformations is cyanuric chloride due to the reactivity of the chlorine atoms towards nucleophiles [10].

2) TRIAZINE AND ITS ANTIBACTERIAL ACTIVITY

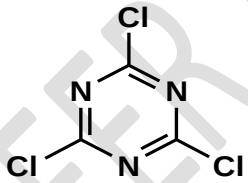


Fig.2.1: 2,4,6 thichloro 1,3,5- triazine (cyanuric chloride).

2.1) Antibacterial activity:

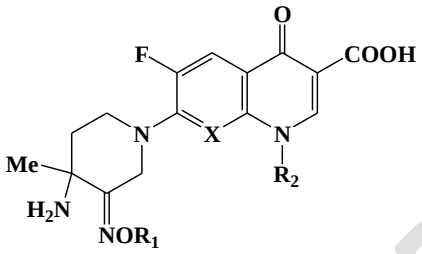
In this review we are going to discuss the antibacterial activity of 1,3,5-triazine derivatives that have been carried out by various researchers. Although a number of work has already been done on this particular, but here some of the important research work on 1,3,5-triazine derivatives have been discussed in brief.

A comprehensive literature survey has been done to search out the current trends in the field of antibacterial. This survey was desigined to find out the different types of molecular structures containing either 1,3,5 triazine. Several publications have focused on derivatives of 1,3,5 triazine with a wide array of substituent.

2.2. Review of the synthetic work

In this part, important research articles has been incorporated which highlights the various synthetic procedures adopted for synthesizing triazine and quinoline derivatives

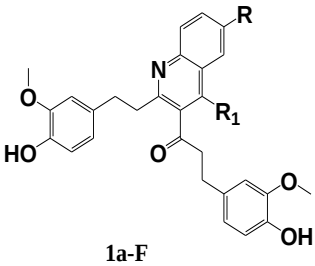
Wang *et al*. (2011) synthesised a series of novel 7-(3-alkoxyimino-4-amino-4-methylpiperidin-1-yl)fluoroquinolone derivatives were designed, synthesized and evaluated for their in vitro antibacterial activity and cytotoxicity. All of the target compounds have potent antibacterial activity against the tested Gram-positive and Gram-negative strains, and exhibit good potency in inhibiting the growth of *Staphylococcus aureus* including MRSA, *Staphylococcus epidermidis* including MRSE and Streptococcus pneumoniae (MICs: 0.125e4 mg/mL). Compound 22 (**Fig 2.2**), with the best activity against Gram-positive strains, is 4e16 fold more potent than gemifloxacin, gatifloxacin and levofloxacin against Enterococcus faecalis, and 16- and 4-fold more potent than levofloxacin against *S. epidermidis* 09-6 and *S. pneumoniae* 08 respectively [11].



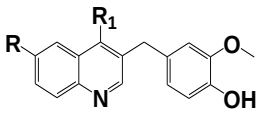
R1=Me
X=COMe
R2=C_4H_8

Fig 2.2.: 7-(3-alkoxyimino-4-amino-4-methylpiperidin-1-yl)fluoroquinolone derivatives

Manjunath et al. (2012) synthesised quinoline derivatives of Tetrahydrocurcumin (THC 1) and zingerone (2) by an efficient protocol involving their reaction with substituted 2-aminobenzophenones and 2-aminoacetophenone. Radical scavenging activities (RSA) of THC, zingerone and their quinoline derivatives were evaluated. Derivatives of THC (1a–1f) (**Fig 2.3**)showed stronger antimicrobial activity than THC (1) against Staphylococcus aureus, Bacillus cereus, Escherichia coli, and Yersinia enterocolitica. Also, derivatives of zingerone (2b–2e) exhibited lower minimum inhibitory concentrations (MIC) values than zingerone (2) and its derivative (**Fig 2.3**), 2a for both Gram-positive and Gram-negative bacteria [12]**.**



1a-F



2A-E

1a: R=H, R1=CH_3: 1b: R=H, R1=Ph; 1c; R=NO_2, R1=Ph; 1d: R=Cl, R1= Ph; 1e: R=NH_2 R1=Ph; 1f: R=-Cl(Ph), R1=Ph
2a: R=H, R1=CH_3; 2b: R=H, R_1=Ph; 2C: R=NO_2, R_1=Ph; 2d; R=Cl, R_1=Ph; R=NH_2, R_1=Ph

Fig 2.3: Quinoline derivatives of Tetrahydrocurcumin and zingerone

Bhat *et al.* (2013) synthesized a series of novel 4-aminoquinoline 1,3,5-triazine derivatives and the synthesized were evaluated for their antibacterial activity using ciprofloxacin as reference standard drug, against three Gram-positive bacteria, namely *Bacillus subtilis*, *Bacillus cereus* and *Staphylococcus aureus*and four Gram-negative bacteria, namely *Proteus vulgaris*, *Proteus mirabilis*, *Escherichia coli*, and *Pseudomonas aeruginosa*, by broth dilution method. Compound **5** (**Fig 2.4**) and **6** (**Fig 2.4**) showed potent antibacterial activity against all bacterial strains except *Bacillus cereus.* Compound **5** bearing P-aminophenol substitution on 1, 3, 5-triazine nucleus showedmore potent antibacterial activity than the **7** (**Fig 2.4**) derivative bearing 1, 3-diaminopropane groups [13].

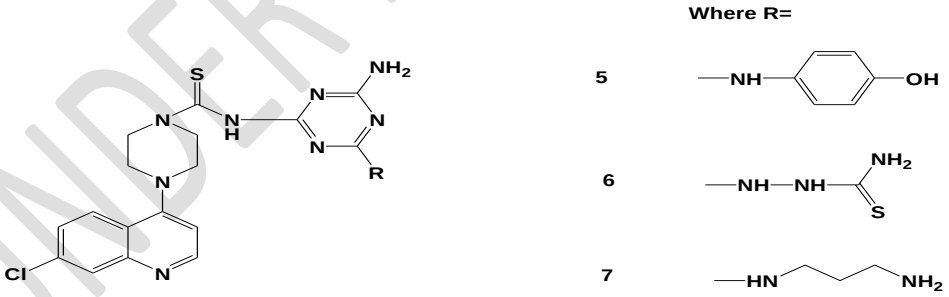
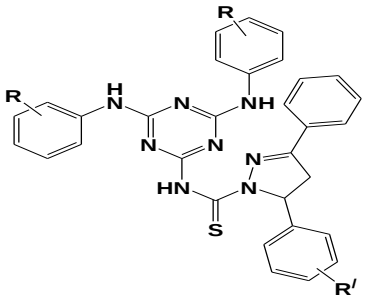


Fig 2.4.: 4-aminoquinoline 1,3,5-triazine derivatives (5,6,7)

Singh *et al.* (2014) synthesized various hybrid of 1,3,5-triazine-pyrazole conjugates with 1,3-thiazine,piperazine, 1,3,4-thiadiazole,4-aminoquiolineand thiazolidin-4-one. The synthesized compounds were evaluated for their antibacterial activity using cefixime as reference standard drug, against Gram-positive bacteria, namely *Bacillus subtilis*, *Bacillus cereus* and *Staphylococcus aureus* and Gram-negative bacteria, namely *Proteus vulgaris*,

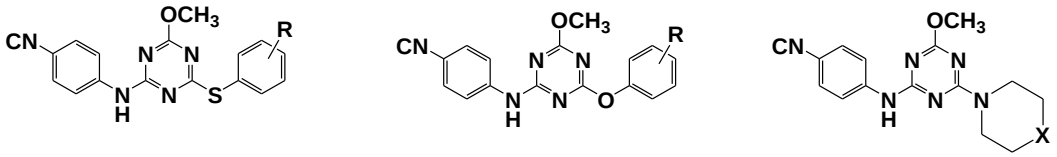
Escherichia coli, and *Pseudomonas aeruginosa*, by broth microdilution method. Due to the presence of unsubstituted phenyl ring on pyrazole, compound **8 (Fig 2.5)** showed significant activity against all the tested micro-organisms except moderate activity against*E. coli* and *P. aeruginosa*. But the introduction of 2-NO_2 (compound **9(Fig 2.5)**) in the substituted phenyl ofpyrazole, led to a decline in activity. The insertion of 2-Cl (compound **10(Fig 2.5))** in the substituted phenyl ring of pyrazoleshowed a marked activity against all tested micro-organisms except *P. Vulgaris*[14].



Where	R	R/
8	4-Cl	H
9	4-Cl	2-NO_2
10	4-Cl	2-Cl

Fig 2.5. hybrid of 1,3,5-triazine-pyrazole conjugates with 1,3-thiazine,piperazine, 1,3,4-thiadiazole,4-aminoquiolineand thiazolidin-4-one.

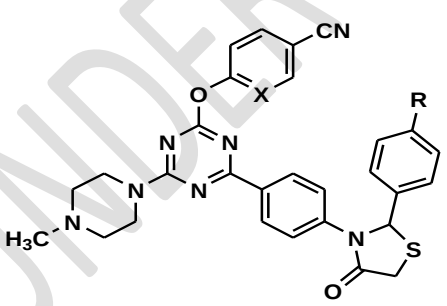
Kishor *et al.* (2014) reported novel *s*-triazine based aryl/heteroaryl entities by substituting the intermediate 4-((4-chloro-6-methoxy-1,3,5-triazin-2-yl)amino)benzonitrile with various thiophenol, phenol, aniline and piperazine/piperidine/morpholine moieties to get the targeted compounds. The synthesized compounds were characterised by different spectroscopic technique and screened for their antibacterial activity against bacteria (*S.aureus*, *B. cereus*, *E. coli*and *P.aeruginosa*). Methyl group containing compound **15** (**Fig 2.6.)** showed superior activity against *E. coli* whereas compound **16 (Fig 2.6.)** and compound **17 (Fig 2.6.)** showed excellent activity against *P.aeruginosa*and *S.aureus*due to the presence of fluoro group. Similarly compound **18 (Fig 2.6.)** having fluoro group exhibited the high potency against bacteria strain *P. aeruginosa* whereas compound **19 (Fig 2.6.)** and **20 (Fig 2.6.)** exhibited potent inhibitory activity against *S.aureus*and *B. cereus*. Compound **21(Fig 2.6.)** having the N-acetyl group showed high potency against the bacterial strain S. aureus and compound **22** (**Fig 2.6.)** having N-phenyl piperazinyl molecule showed superior to other with respect to inhibiting the growth of *P. aeruginosa* [15].



Where R=				Where X=	
15	4-CH_3	18	2-F	21	N-$COCH_3$
16	3-F	19	3-F	22	N-C_6H_5
17	4-F	20	4-F		

Fig 2.6. triazine based aryl/heteroaryl entities

Kumari *et al*. (2014) reported 4/6-(4-(4-methylpiperazin-1-yl)-6-(4-(4-oxo-2-phenylthiazolidin-3-yl)phenyl)-1,3,5-triazin-2-yloxy)benzonitriles/nicotinonitriles derivatives, which were characterised by several spectroscopic and elemental analysis and tested for *in-vitro* antimycobacterial activity against *Mycobacterium tuberculosis*. Benzonitrile based compound **36** and nicotinotrile based compounds **37(Fig 2.7.)**, **38** (**Fig 2.7.**) and **39 (Fig 2.7.)** exhibited highest inhibitions at concentration level 6.25 µg/ml. Compound **38** (**Fig 2.7.**) with hydroxyl group to thiazolidin-4-one showed inhibition against *Mycobacterium tuberculosis* at 3.12 µg/ml of MIC and compound **37** (**Fig 2.7.**) with fluoro group and compound **39** (**Fig 2.6.**) with methoxy group substituent to thiazoliduine-4-one showed inhibition at 6.25 µg/ml of MIC [16].



Where	R	X
36	OH	CH
37	F	N
38	OH	N
39	OCH_3	N

Fig 2.7. 4/6-(4-(4-methylpiperazin-1-yl)-6-(4-(4-oxo-2-phenylthiazolidin-3-yl)phenyl)-1,3,5-triazin-2-yloxy)benzonitriles/nicotinonitriles derivatives

Kishor *et al.* (2014) reported some new quinolone condensed *s*-triazine derivatives (**Fig 2.8.**) endowed with different heterocycles and 4-aminobenzonitrile moiety and evaluated for their antibacterial activity against eight bacteria, namely *Staphylococcus aureus*, *Bacillus cereus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Klebsiella pneumonia*, *Salmonella typhi*, *Proteus*

vulgaris and *Shigella flexineri*. Compounds with halogen substituents, **40(-Cl), 41 (-Br)** and **42 (-F)** showed significant inhibition against both Gram-positive and Gram-negative bacteria at MIC of 6.25-12.5 µg/ml and MIC of 25 µg/ml respectively. However the compound **42** having fluoro substituent was found more active than the other halogen substituent. Compound **43** (thiazole), **44** (benzothiazole) and **45** (nitro heterocycles) exhibited diminished antibacterial efficacies against *Klebsiella pneumonia*at MIC of 50 µg/ml. Compound **46** and **47** having quinoline moiety on *s*-triazine showed excellent activity against *Salmonella typhi* at MIC of 12.5 µg/ml [17].

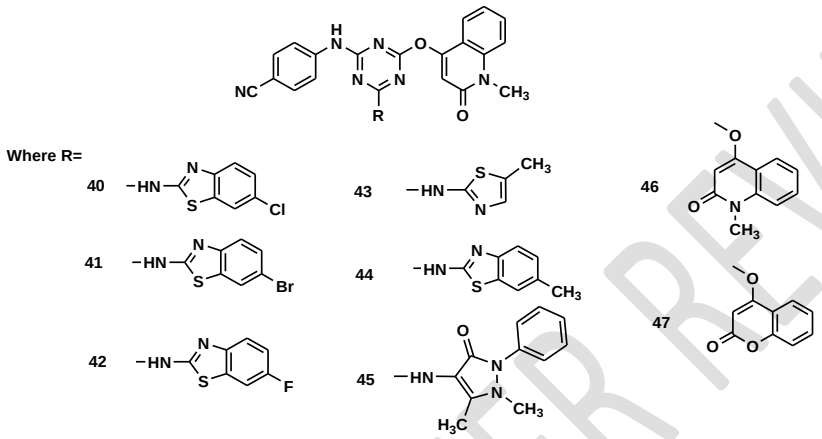
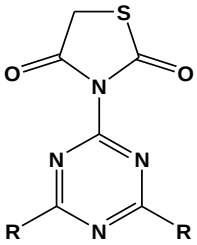


Fig 2.8. quinolone condensed *s*-triazine derivatives

Singh *et al.* (2015) Synthesized a novel series of 1, 3, 5 triazine-thiazolidine-2, 4-diones and characterised by various analytical and spectroscopic techniques. The synthesized compound (**Fig 2.9.**) **11** showed potent activity against all the microorganisms except *Proteus vulgaris*and *Pseudomonas aeruginosa.* Compound **12** showed moderate to zero activity against the tested microorganisms. Compound **13** showed equipotent activity in comparison to standard against *E. coli* where compound **14** showed improved activity in comparison to standard against *E. coli, B. subtilis* and *S. aureus* [18].

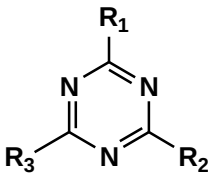


Where R=

11	**NHC_6H_5 2-NO_2**
12	**$NHNH_2$**
13	**NHC_6H_5**
14	**NHC_6H_5 2-NH_2**

Fig 2.9.: 1, 3, 5 triazine-thiazolidine-2, 4-diones

Shafi *et al*. (2015) reported a series of s-triazine derivatives by treating 4,7-dichloroquinoline with ethylene diamine afforded 4-substituted 7-chloroquine, which further reacted with 1,5-disubstituted cyanuric chloride. All the synthesized compounds (**Fig 2.10.**) were characterized by different spectroscopic techniques and evaluated for their antibacterial activity against some Gram positive and Gram negative bacteria. Compound **29**, **30** and **31** exhibited good inhibition against all the tested bacteria, whereas compound **32**, **33** and **34** exhibited moderate to low activity against all strains [19].



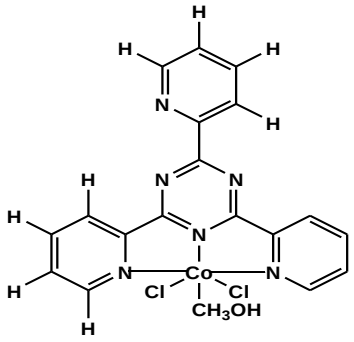
Where

R_1, R_2=P-Nitroaniline and R_3=N^1-7(Chloroquinoline-4-yl)ethane-1,2-Diamine for compound 29, 30 and 31.

R_1=P-Nitroaniline, R_2= Aniline and R_3=N^1-7(Chloroquinoline-4-yl)ethane-1,2-Diamine for compound 32, 33 and 34.

Fig 2.10. s-triazine derivatives

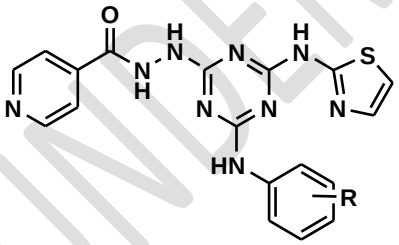
Farzaneh *et al.* (2015) prepared a cobalt complex from $CoCl_2$.6H2O and 2,4,6-tris(2 pyridyl)-1,3,5-triazine**(tptz)** and characterised by several spectroscopic techniques and TGA analysis. The complex (**Fig 2.11.**) was screened for antibacterial activity against Gram positive bacteria, namely *Bacillus subtilis*and *Staphylococcus aureus* and Gram-negative bacteria, namely *Escherichia coli*, and *Pseudomonas aeruginosa* using Nalidixic acid and Vancomycin as reference standard. Tptz exhibited moderate activity against *B. subtilis* and *S. aureus* and *P. aeruginosa* including no activity against *E. coli*. When compared to parent ligand, all the complexes (compound **35**) exhibited more inhibition than parent ligand [20].



35 cobalt complex

Fig 2.11. cobalt complex

Desai *et al.* (2016) reported a series of novel compounds N/-(4-(arylamino)-6-(thiazol-2-ylamino)-1,3,5-triazin-2-yl)isonicotinohydrazides by a series of multistep reactions and the compounds (**Fig 2.12**) were characterised by different spectroscopic techniques. Antimicrobial screening of title compounds was evaluated against Gram-positive bacteria (*Staphylococcus aureus, Streptococcus pyogenes*), Gram-negative bacteria (*Escherichia coli, Pseudomonas aeruginosa*) by using serial broth dilution method. Compound **23** (2-NO_2) and compound **24** (4-NO_2) showed highest inhibition at MIC 12.5 and 25 µg/ml while compound **25** (2,5-$(Cl)_2$) and compound **26** (4-F) displayed a significant activity at MIC 50 µg/ml against *E. coli*. Compound **27** showed a very good activity at MIC 50 µg/ml against *P. aeruginosa* compound **28** displayed pronounced activity at MIC 50 µg/ml against *S. aureus* [21].

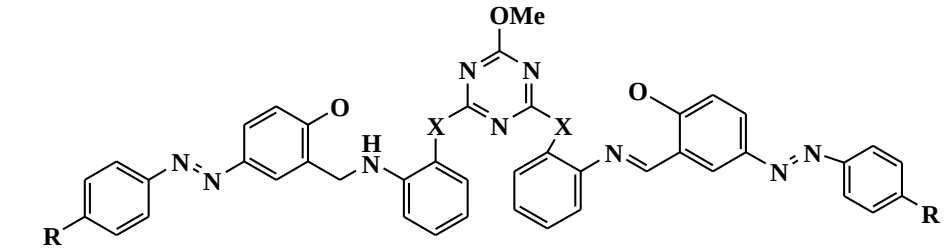


Where R=			
23	**2-NO_2**	**26**	**4-F**
24	**4-NO_2**	**27**	**4-Br**
25	**2,5-$(Cl)_2$**	**28**	**4-F**

Fig 2.12. N/-(4-(arylamino)-6-(thiazol-2-ylamino)-1,3,5-triazin-2-yl)isonicotinohydrazides

Ali *et al.* (2016) synthesized 2,2'-(((6-methoxy- 1,3,5-triazine-2,4 diyl)bis(sulfanediyl)bis(2,1-phenylene))bis(azanylylidene)bis (methanylylidene))bis(4-(phenyldiazenyl)phenol and its derivatives (**Fig 2.13**), were characterised by elemental analysis and spectroscopic techniques and screened for their antibacterial activity against

some Gram positive and Gram negative bacteria by disc diffusion method. In the disc diffusion antimicrobial sensitivity testing, none of the compounds showed inhibitory effects against all the tested pathogens [22].

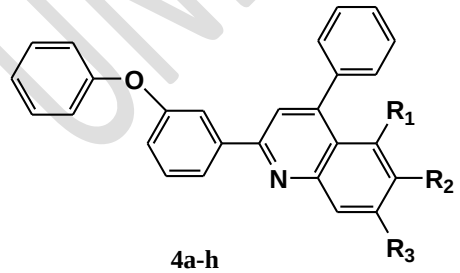


X=S **X=O**

a R=H, b R=Me, c R=Cl, d R=NO_2 **e R=H, f R=Me, g R=Cl, h R=NO_2**

Fig 2.13. 2,2'-(((6-methoxy- 1,3,5-triazine-2,4 diyl)bis(sulfanediyl)bis(2,1-phenylene))bis(azanylylidene)bis (methanylylidene))bis(4-(phenyldiazenyl)phenol

Manikand *et al.* (2017) synthesised 6-substituted-2-(3-phenoxyphenyl)-4-phenylquinoline derivatives (4a-h) as antibacterial activity was reported. Antimicrobial activity of the compounds (**Fig 2.14.**) on Gram-ve bacteria *Escherichia coli* (MTCC 443), *Pseudomonas aeruginosa* (MTCC 424), and Gram+ve bacteria *Staphylococcus aureus* (MTCC 96) and *Streptococcus pyogenes* (MTCC 442) was evaluated. Antimicrobial activity potentials of newly synthesized and well characterized 6-substituted-2-(3-phenoxyphenyl)- 4-phenylquinoline derivatives (4a–h) were evaluated. Selectivity on Gram+ve bacteria was understood and *S. aureus* DNA gyrase A inhibition was proposed for the compounds 4a–h. Compounds 4c, 4d, 4e and 4h were found as the most potent antibacterial agents [23].



4a-h

4c: R1=H, R2=F, R3=H
4d: R1=H, R2=CN, R3=H
4e; R1=H, R2=OH, R3=H
4h; R1=Cl, R2=OH, R3=Cl

Fig 2.14. 6-substituted-2-(3-phenoxyphenyl)-4-phenylquinoline derivatives

Zhang X. *et al*. (2017) synthesized two covalent organic frameworks, namely COFs-Trif-Benz and COF-SDU1 by facile solvo thermal reaction between tri-(4-formacylphenoxy)-1,3,5-triazine (trif) and benzidine or *p*-phenylenediamine and the structures were confirmed by FTIR, NMR, PXRD and BET analyses. The two material was the evaluated for antibacterial activity against Gram positive (*S. aureus*) and Gram negative (*E. coli*) bacteria [24].

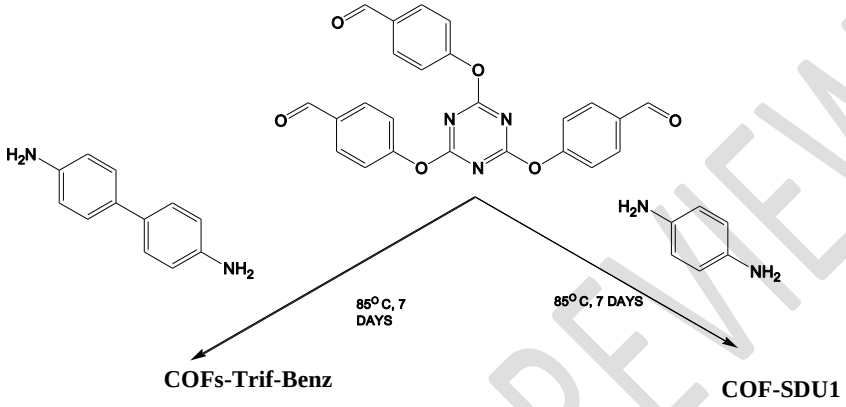
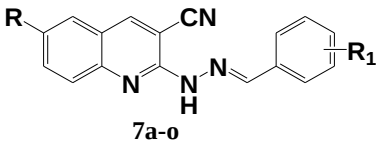


Fig 2.15.: synthetic scheme of two covalent organic frameworks, namely COFs-Trif-Benz and COF-SDU1 by facile solvo thermal reaction

Kamal et al. (2018) synthesised a series of novel sixty three quinoline-3-carbonitrile derivatives. The synthesized compounds (**Fig 2.16.**) were characterized by various spectroscopic techniques and evaluated for their antibacterial using agar diffusion technique. The compounds which exhibited a higher inhibition zones were than further tested to determine their minimum inhibitory concentrations (MIC) by the use of a serial dilution technique. The results showed that all the synthesized compounds i.e. 6-substituted quinoline-3-carbonitrile derivatives proved to be interesting lead molecules as antimicrobial agents. the successful synthesis of different heterocyclic moieties attached at position-3 to the 6-substituted quinoline-3-carbonitrile were reported with moderate yields. The antibacterial activity evaluation suggest that the out of all compounds that were synthesised quinoline derivatives of the tested compounds 7a, 7g, 7i, 7l and 7o were the most active substituents. Their MIC were 12.550 mg/ml against Gram-positive and Gram-negative bacteria using ampicillin and ciprofloxacin as standard for comparision[24]

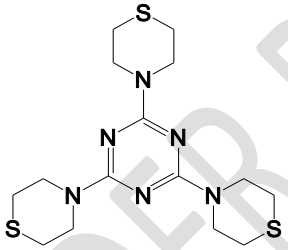


7a-o

7a.; R=H, R1=$_2$-Cl
7g; R=H, R1=2,6(Cl)$_2$
7i; R=OCH$_3$,R1=2,6(Cl)$_2$
7l; R=OCH$_3$,R1=4-OCH$_3$
7o; R=OCH$_3$,R1=3,4,5(OCH$_3$)$_3$

Fig 2.16. quinoline-3-carbonitrile derivatives

Martin *et al.*, (2019) synthesized 2,4,6-tris(thiomorpholine)-1,3,5-triazine, 2,4,6-tris(piperazine)-1,3,5-triazine and their new Sb(III) and Bi(III) complexes. The synthesized compounds were than characterised by different spectroscopic technique and screened for their antibacterial activity against bacterial species *Staphylococcus aureus.* The antibavterial evaluation of those synthesised complexes shopwed that Sb(III) complexes exhibited quite moderate activities against the tested strains of bacteria with minimum inhibitory concentration (MIC) in range of 512-1024 mg/mL [26].



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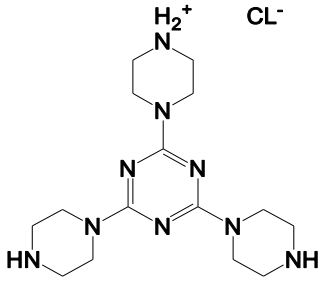


II

Fig 2.17: 1,3,5 triazine derivative ligands where,
I- 2,4,6-tris(thiomorpholine)-1,3,5-triazine.
II- 2,4,6-tris(piperazine)-1,3,5-triazine.

Masih *et al.*, (2020) synthesized a series of dihydydropyrimidine-1,3,5-triazines. The synthesized compounds were than subjected to molecular docking and antibacterial activity evaluation of of three Gram-positive, *viz. Staphylococcus aureus, Bacillus subtilis*, *Bacillus cereus* and three Gram-negative bacterial strains *viz. Pseudomonas aeruginosa, Escherichia coli*, and *Proteus vulgaris*. The antibacterial activity evaluation showed significant to moderate antibacterial activity. The compound also exhibited a very distinct antibiofilm

activity against *S. aureus* and *B. subtilis.* The 11th and the 12th compound proved to be most potent as it was found to be bacteriostatic in time-kill assay using numerous H-bonds via inhibition of DNA gyrase enzyme and interacting with Glu58, Val130, Ile175 and Ile186 [27].

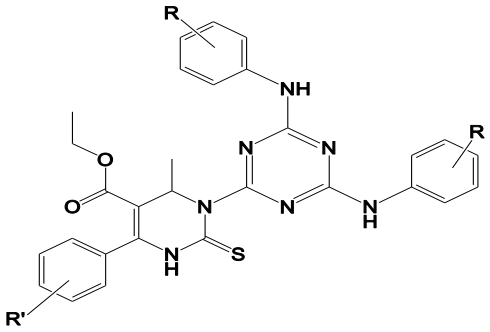
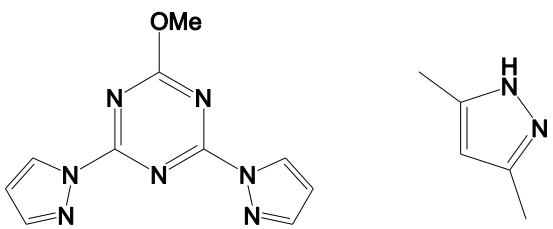


Fig 2.18: dihydydropyrimidine-1,3,5-triazine derivatives, where
11th compound:- R=3-F R'=4-F
12th compound:- R= 3-Cl R'=4-F

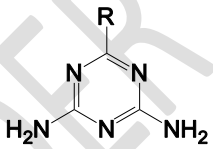
Soliman *et al.*, (2020): synthesized [Zn(BPT)(NO3)2] (2), and [Zn(BPT)(H2O)Cl]ClO4 (3) complexes, respectively upon reacting 2,4-bis(3,5-dimethyl-1H-pyrazol-1-yl)-6-methoxy-1,3,5-triazine (BPT) pincer ligand with Zn(NO3)2 and Zn(ClO4)2·6H2O/HCl. On the other hand [Zn(DMP)2Cl2] (1) complex (DMP = 3,5-dimethylpyrazole) was obtained upon reacting zinc(II) chloride with BPT which involved C-N rupture. The synthesised complexes were characterised by different spectroscopic technique and screened for their antibacterial activity against *E. Coli, B. subtilis, B. cereus, P. aeruginosa, St. aureus.* The antibacterial activity evaluation was done by determining the MICs values of the studied Zn(II) complexes and compared with Amoxicillin antibiotic (which was used as standard). The result obtained after completion of the process showed that the complexes [Zn(BPT)(NO3)2] (2), and [Zn(BPT)(H2O)Cl]ClO4 (3) are more potent antimicrobial agents against the studied microbes in comparison with complex [Zn(DMP)2Cl2] (1) [28].



BPT **DMP**

Fig 2.19: Structure of the s-triazine based ligand (BPT) and 3,5-dimethylpyrazole (DMP).

Patil. *et al.*, (2020) synthesized a series of 1,3,5-triazine derivatives (3a-o)were characterised by different spectroscopic technique and screened for their antibacterial activity against against five bacterial strains, *Staphylococcus aureus (S. aureus), Escherichia coli (E. coli), Klebsiella pneumonia (K. pneumonia), Acinetobacter baumannii (A. baumannii) and Pseudomonas aeruginosa (P. Aeruginosa.* The result obtained after the antibacterial evaluation showed that the synthesized compounds were moderate to vey potent against the bacterial growth. The compound 6-(thiazol-4-yl)-1,3,5-triazine-2,4-diamine (**3o**) was found to be very active against the strains of *E. coli, K. pneumoniae, A. Baumannii.* The molecular docking study of those compounds also showed a very prominent result when performed on X-ray crystal structure of E. coli 24 kDa domain in complex with clorobiocin (PDB code: 1KZN; resolution 2.30 Å) using Surflex-Dock program of Sybyl-X software [29].



Where R(3o)=

Fig 2.20: 1,3,5-triazine derivatives

3. CONCLUSION:

Now a days like other drugs, antibacterial drugs are also commonly misused by health professionals. Antibacterial resistance has become one of the global serious threats to human health. In addition to the very swift replication and the high mutation rate of bacteria, the excessive utilization of existing antibiotics resulted in occurrence in many difficulties to treat illnesses. Up to 75% of antibacterial drugs that are currently used clinically are of

questionable therapeutic value. The resistance problem demands that a scientific effort be made to seek antibacterial agents effective against pathogenic bacteria resistant to current antibiotics. One of the possible strategies towards this objective is rational localization of bioactive photochemical. Thus making an approach for newer antibiotics is of outmost need. One of this approach is to develop newrer derivaties of 1,3,5 triazine, as triazine derivaties have found an extensive use in treating bacterial infection. In this paper we have made an extensive literature survey which compiles the effectiveness of various 1,3,5- triazine derivaties proved by various research works. From this paper, it can be concluded that the compounds various types substitutions on cyanuric chloride are potential key approach to design newer antibacterial agents. On the basis of the study carried out in this paper we can put these investigated molecules not only as lead for further synthetic and biological evaluation pursuit to discover novel class of antibacterial agents but it can also show a better path for future researchers to make an approach for developing newer antibacterial 1,3,5-triazine derivaties.

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