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Review Article

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Benzothiazole: Heterocyclic Compound A Review

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Abstract We have an unlimited supply of therapeutic molecules because to heterocyclic chemistry. The biological actions of the benzothiazole ring system include anxiolytic, ant allergic, cardiovascular, anti-diabetic, anti-psychotic and antioxidant effects etc. Such as benzothiazole moieties and their derivatives, are a major class of molecules in medicinal chemistry. They also offer a wide range of coordinative properties attributed to the combination of additional donor sites including nitrogen, sulphur, and oxygen atoms, which serve as a scaffold for the synthesis of new active molecules. Benzothiazole has been shown to be a miraculous molecule in the realm of drug discovery. To anticipate their molecular property, drug similarity, total drug score and toxicity concerns, which are required for a chemical to be classified as a drug, computational algorithms were applied.

Keywords: Benzothiazole, pharmacological activity, antineoplastic etc.

Introduction

Heterocyclic compounds with N and S hetero-atoms are important in medication development. Because it is a hetero molecule, benzothiazole is used as a start material in research to created a variety of bioactive structures [3]. Benzothiazole analogues are a diverse family of chemicals that may be found in a variety of marine and terrestrial natural products. Benzothiazole compounds are significant guide frames and parent skeletons in medicinal chemistry and agrochemicals, and they have a broad biological effect on benzothiazole derivatives' antibacterial efficacy against pathogenic fungi and bacteria [7]. Some benzothiazoles have been found useful in bioorganic and medicinal chemistry as well as in the development of clinical drugs such as pramipexole, lubeluzole, probenazole, ethoxazolamide and zopolrestat [9]. This is evident from the fact that benzothiazole is used extensively in the design and development of antiviral drugs. The current review is intended to provide an insight into the recent development of benzothiazole-based antiviral drugs. We identified 105 articles with a special focus on their structure-activity relationships and lead optimization. Out of these studies, 64 potential novel lead molecules and main findings were highlighted in this review [10].

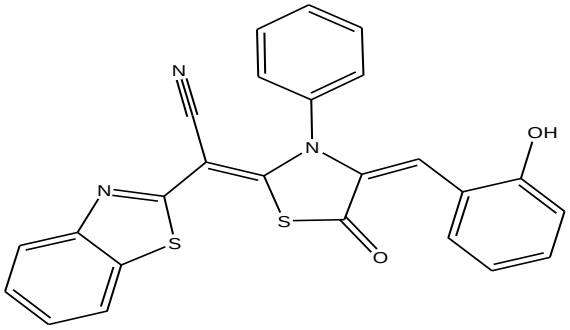
Biological Activity

The antibacterial, antileishmanial, anti-tumor, anthelmintic, anti-inflammatory, and anticonvulsant characteristics of the benzthiazole nucleus may be found in study mixtures**.** The current investigation is focused on benzothiazoles and the prospective workouts that are already being used. Benzothiazole compounds have sparked fresh research efforts in the pharmaceutical sector in search of newer derivatives with superior biological activity and a variety of uses.

Because of the relevance of this system, the purpose of this investigation is to highlight recent viewpoints on the science, chemistry, and biological activity of benzothiazoles [12].

1. Cytotoxicity

Lamia W. Mohamed *et al* (2016) As cytotoxic agents, a variety of benzothiazole has been produced, where2-([1,3]benzothiazol-2-yl)-2-(4-(2-hydroxybenzylidene)-5-oxo-3-phenyl-thiazolidin -2- ylidene) acetonitril was shown to be more powerful than cisplatin, with IC50 values of 8.64, 7.39, 7.56, 5.15 M compared to 13.33 M for cisplatin [4]. In addition to ^{1}H and ^{13}C NMR, FT-IR, elemental analysis, and mass spectroscopy, the synthesized compounds were examined for their properties.

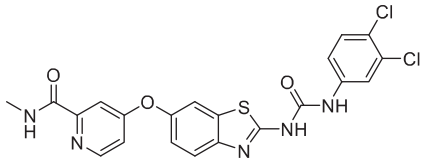


2-([1,3]benzothiazol-2-yl)-2-(4-(2-hydroxybenzylidene)-5-oxo-3-phenyl-thiazolidin -2-ylidene)acetonitrile

1a

2. Anticancer agents

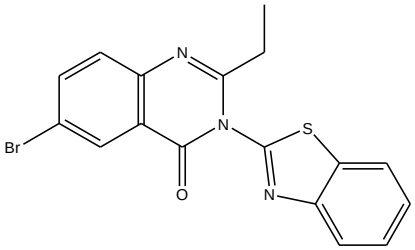
In a recent study, Singh et al.(2020) described the synthesis of imidazole based benzothiazoles by treating substituted anilines with KSCN, which produced benzothiazole derivatives, and studied their anticancer properties. As compared to doxorubicin, the compound had IC50 value of 10 mM, showing excellent anticancer activity.[10]



3. Anti-consulvant

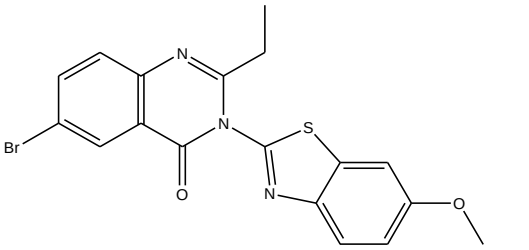
New benztriazoles containing mercapto-triazole and other heterocycle substituents were tested for anticonvulsant effect and neurotoxicity using the maxim electroshock (MES), subcutaneous pentylenetetrazole (sc PTZ), and rotarod neurotoxicity (TOX) assays.

Vinod G. Ugale a *et al.* (2012) A progression of 6-bromo-2-ethyl-3-(substitutedbenzo[*d*]thiazol-2-yl)quinazolin-4(3*H*)-one were incorporated utilizing suitable engineered course and S tentatively by the Maximal Electro Shock (MES) and PTZ-incited seizure techniques. Among the tried mixtures, 3-(benzo[*d*]thiazol-2-yl)-6-bromo-2-ethylquinazolin-4(3*H*)-one has shown huge action against tonic seizure by the MES model and 6-bromo-2-ethyl-3-(6-methoxybenzo[*d*]thiazol-2-yl)quinazolin-4(3*H*)- one against clonic seizure by PTZ-actuated seizure model and it is characterized by NMR & mass spectral [5].



3-(benzo[d]thiazol-2-yl)-6-bromo-2-ethylquinazolin-4(3H)-one

(2a)

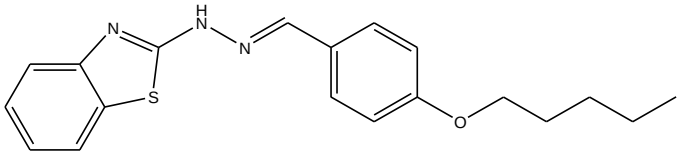


6-bromo-2-ethyl-3-(6-methoxybenzo[d]thiazol-2-yl)quinazolin-4(3H)- one

(2b)

4. Anti-Tubercular

Vikas N. Telvekar et al.(2012) Molecular hybridization was used to develop and synthesis a series of structurally new substituted 2-(2-(4-aryloxybenzylidene) hydrazinyl)benzothiazole derivatives, which included 2-hydrazinyl benzothiazole and 4-(aryloxy)benzaldehyde. All of the produced compounds showed potential action against Mycobacterium TB H37Rv strains of Mycobacterium tuberculosis (MIC 1.5–29.00 lg/ml) [6].



2-(2-(4-amyloxybenzylidene) hydrazinyl)benzothiazole

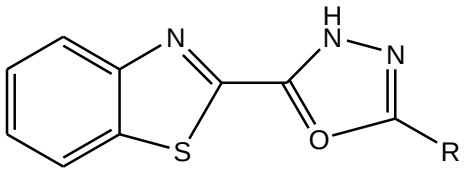
(3a)

5. Antimicrobial

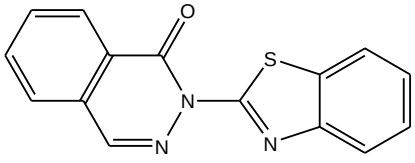
S.M.Shantakumar *et al*. In this study, 2-(5-substituted-1,3,4-oxadiazole-2-yl)-1,3-benzothiazole has been synthesized by refluxing benzothiazolyl carboxyhydrazide with aryl acids in phosphoryl chloride. Structures of the synthesized compounds were established based on ^{1}H NMR and Mass spectral data.

In order to assess the anti-bacterial activity of the synthesized compounds, disc diffusion was applied [7].

The newly synthesiszed compounds were characterized by IR,Proton nuclear megnetic resonance (PNMR), CORBON -13 and 4a ,4b were the greatest active result identified during antimicrobial activity screening.



(4a)



2-Benzothiazol-2-yl-2H-phthalazin-1-one

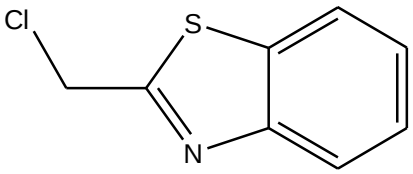
(4b)

R= C_7H_8 ,C_6H_5Br

6. Antifungal

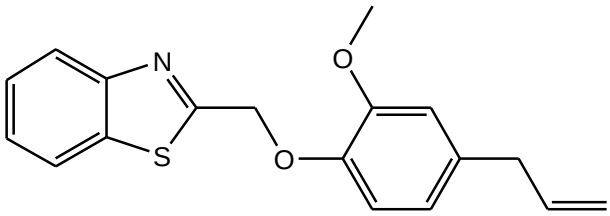
Based on the 2-(aryloxymethyl)benzothiazole scaffold as an influential pharmacophore, a series of 2-(aryloxymethyl)benzothiazole derivatives were synthesized and their antifungal effects evaluated against eight phytopathogenic fungi Most of the pathogens tested were sensitive to compounds 5a antifungal properties.

According to Bo Luo, Ding Li *et al.* (2018) As part of the research on antifungal compounds, benzothiazole derivatives have been designed and synthesized by etherification reaction; their structures have been evaluated by ^{1}H and ^{13}C-NMR spectroscopy and mass spectrometry (MS). Finally, their antifungal activities against eight phytopathogenic fungi have been evaluated by mycelium growth rate as well as the structure-activity relationships of these derivatives were discussed [11].



2-(chloromethyl)benzo[*d*]thiazole

(5)

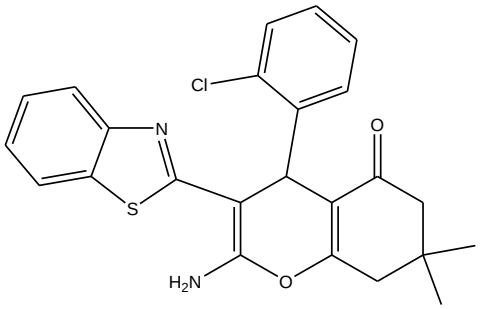


2-((4-allyl-2-methoxyphenoxy)methyl)benzo[d]thiazole

(5a)

7. Antiinflammatory

Divyani G. *et al*. 2018 were synthesized a series of chromene derivatives by multistep synthesis process using 2-[3-phenyl prop-2-ene nitrile] 1,3-benzothiazole and dimedone using piperidine as catalyst in ethanol. All the novel derivatives were screened for their *in-vivo* anti-inflammatory activity. The compound 7 having most potent compound exhibited 52.77% inhibition and found to be quite superior in activity [12]. The medicine (Diclofenac) is an NSAID (nonsteroid anti-inflammatory drug) that works at the peripheral level rather than the central nervous system (Central Nervous System). These medications work at the site of tissue injury to block the cyclooxygenase (COX) pathway, preventing the formation of ecosanoids.

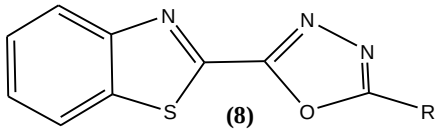


2-amino-3-(benzo[*d*]thiazol-2-yl)-4-(2-chlorophenyl)-7,7-dimethyl-7,8-dihydro-4*H*-chromen-5(6*H*)-one

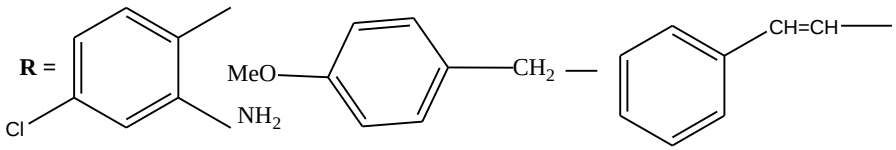
(7)

8. Antibacterial

S.M.Shantakumar *et al* (2009) synthesized a sequence of By disc diffusion method,6 Substituted 8a,8b,8c newly synthesized compounds were evaluated for in vitro antibacterial activity against gram positive and gram negative bacterial strains such as Bacillus subtilis, Bacillus pumilus, Escherichia coli, and Pseudomonas aureginosa at concentrations of 100 g/mL, using DMSO as a solvent control and nutrient agar as culture media. The zone of inhibition was measured in millimeters after 24 hours of incubation at 37 degrees**.** Antibacterial activity experiments were performed at a concentration of 100 g/mL using DMSO as a control and ciprofloxacin as a standard against gram positive and gram negative microorganisms [13].



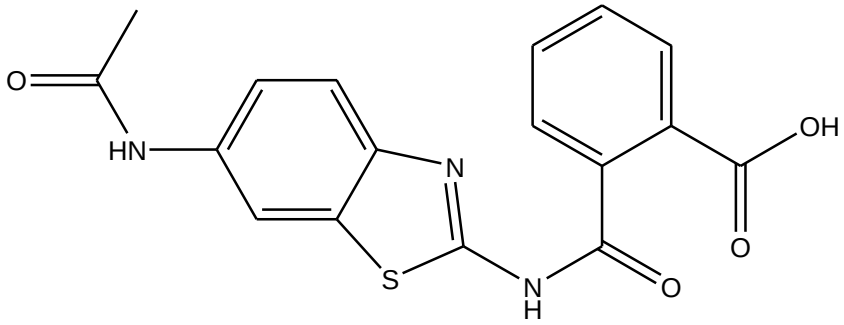
(8)



(8a) **(8b)** **(8c)**

9. Analgesic

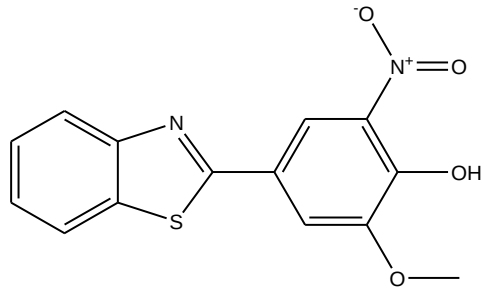
Martin *et al* (2014) The corresponding Schiff's bases were obtained by treating a parent benzothiazole nucleus with different substituted aromatic aldehydes, followed by treatment with pthalic anhydride to generate 2-(6-acetamidobenzo[*d*]thiazol-2-ylcarbamoyl)benzoic acid. Various spectroscopic approaches, such as IR, ^{1}H NMR, and mass spectroscopy, were used to confirm the structures 9 produced compounds. the analgesic properties of the products were tested. When compared to the standards, some of the compounds showed significant activity [15].



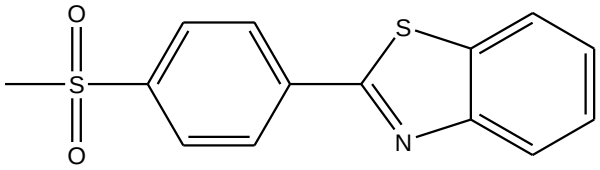
2-(6-acetamidobenzo[d]thiazol-2-ylcarbamoyl)benzoic acid
(9)

10. Antioxidant

Shaista et al. synthesized a number of benzothiazole molecules (2020). The reactions were monitored using thin layer chromatography, and the freshly synthesized derivatives were characterized by ATIR and proton nuclear magnetic resonance (^{1}H-NMR). The antioxidant assay was carried out using the 2,2′-Azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) (ABTS) and 2,2-Diphenyl-1-Picrylhydrazyl (DPPH) techniques. The ABTS assay was found to have better antioxidant activity than the DPPH assay. The radical scavenging capacity of the synthesized benzothiazole derivatives was demonstrated [16].



4-(benzo[*d*]thiazol-2-yl)-2-methoxy-6-nitrophenol
(10a)



2-(4-methanesulfonyl phenyl)-1,3-benzothiazole
(10b)

Conclusion

This comprehensive investigation shows that thiazole has antifungal and anticancer properties. The finding of possible cancer therapeutic compounds further demonstrates the biomedical sector's importance a benzothiazole based derivative, was shown to have differential toxicity towards tumour cell types. The goal of this review article study was to look at the activity *in vitro*. Benzothiazole in conjunction with other heterocycle rings may be the catalyst for effective action, according to the findings.

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