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Review Article

Nanocatalyzed Synthetic Approach for the Quinazolinone and Quinazoline Derivatives: A Review (2015 – Present)

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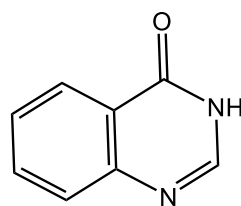
Abstract

Due to their diverse chemical reactivities and essential range of biological action, quinazolines and their derivatives rank among the most significant heterocyclic compounds. Quinazolinone and quinazolinone scaffolds pharmacological properties have sparked medicinal chemists' interest in creating original medications or drug candidates. The growth of quinazolinone hybrid lead compounds and the related heterocycles is summarised in the current review of medicinal chemistry. Additionally, by shedding light on the potential significance of these hybridised pharmacophoric characteristics in the demonstrating a range of pharmacological activities, the review contributes to the acceleration of the drug development process.

Keywords: Fused Heterocycles, Quinazolinone and Quinazoline Derivatives, Drug Development

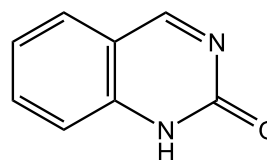
INTRODUCTION

The among a wide variety of the nitrogen heterocycles that have explored for pharmaceutically important roles, quinazolinone are one of the category of fused heterocycles that are of considerable interest¹.



quinazolin-4-one

(a)



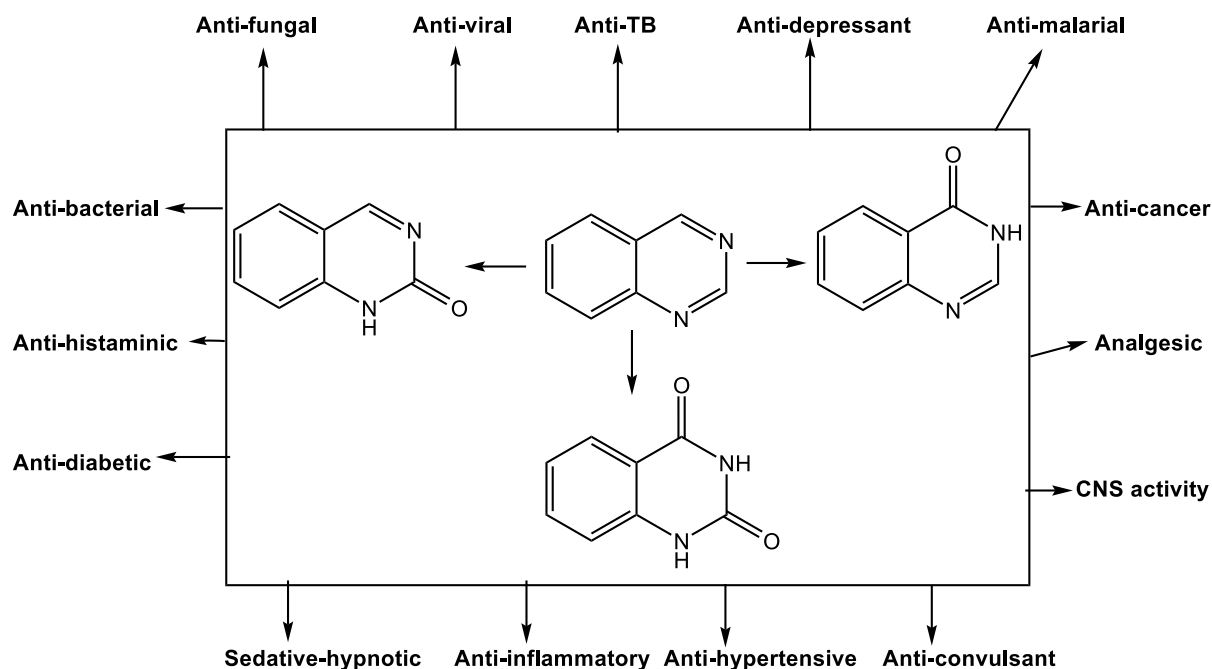
quinazolin-2-one

(b)

Manufacture the of small molecule mimics of biological structures is a key contribution of organic chemistry to the invention of the new pharmaceuticals with the wide range of biological activities. There are two structural isomers, quinazolin-4-one (a) and quinazolin-2-one (b) with the 4-isomer being the more common².

Heterocyclic rings containing nitrogen and sulfur are of much intention as they are therapeutically and pharmacologically more active. These substances serve as the foundation for numerous pharmacological products. For this review,

quinazolinone has been chosen among all heterocyclic moieties since it has a very wide range of the pharmacological activity and little negative side effects³.



Due to the wide diversity of their biological or organic properties, the classes of fused heterocycles quinazolines and quinazolinones are of the great interest⁴.

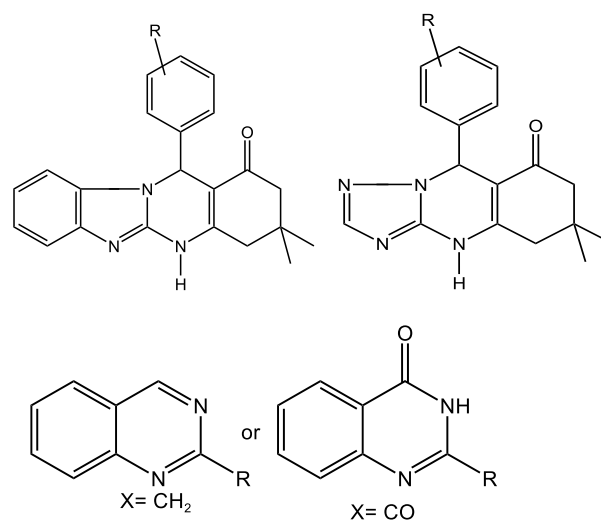
Biological significance of the quinazoline and its derivatives includes the following:-

In 2022

The TiO₂ was used as a effective nanocatalyst in the one-pot multicomponent reactions involving 3-amino-1,2,4-triazole or 2-aminobenzimidazole, dimedone, and aromatic aldehydes to create triazoloquinazolinone and benzimidazoquinazolinone derivatives⁵.

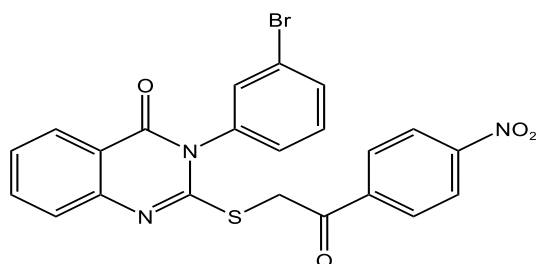
The quinazoline compounds exhibit a range of pharmacological and the physiological activities. The most frequent syntheses require a lot of oxidants, a lot of heat, and

other harsh conditions. In this investigation, quinazoline compounds were produced without the use of transition metal catalysts or additives by condensation of keto acid and 2-aminobenzylamine followed by decarboxylation at room temperature⁶.

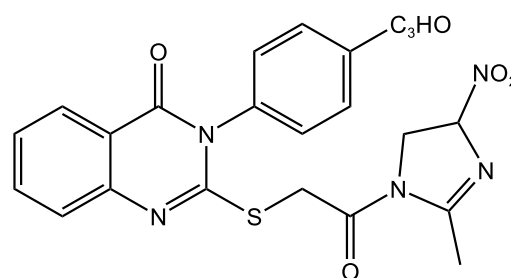


In 2021

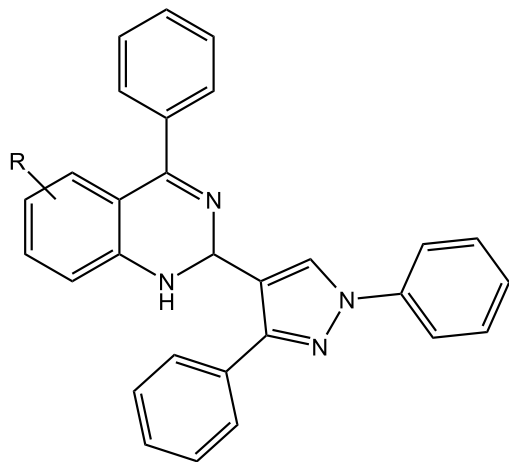
The effects of the quinazolinone analogues on alpha-glucosidase inhibition were developed and evaluated. Results revealed that the most tested members were powerful and significantly inhibited the alpha-glucosidase enzyme when compared to conventional acarbose⁷.



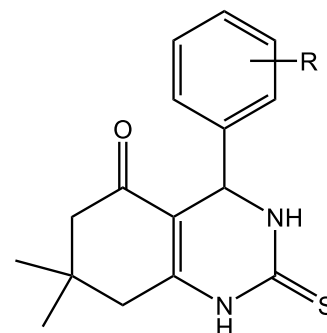
Quinazolinone-2-thio-metronidazole derivatives were created, produced, and tested for their efficacy against the enzyme glucosidase. The results indicated that all the synthesized compounds exhibited excellent inhibitory activities against mentioned enzyme as compared with standard inhibitor. Biological testing prove that mainly α -glucosidase inhibitor was compound with 4-methoxyphenyl moiety. It was 5-times more active that acarbose as the standard inhibitor⁸.



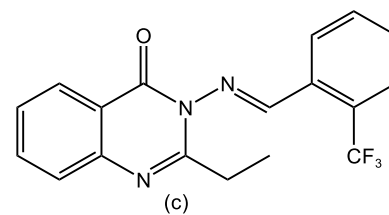
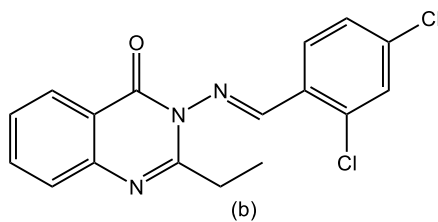
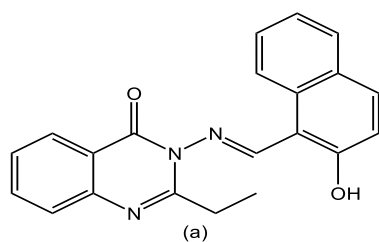
Mahesh reported an environmentally friendly method for producing zinc oxide nanoparticles (ZnO-NPs) at the room temperature employing sunflower leaf aqueous extract. The produced nanocatalyst was shown to be an effective and useful catalyst separation of 2-(1,3-diphenyl-1H-pyrazol-4-yl)-4-phenyl-1,2-dihydroquinazoline derivatives through a one-pot reaction of 2-amino benzophenone, 1,3-diphenyl-1H-pyrazole ammonium acetate and carbaldehydes, in green protocols⁹.



Recently, reported the zinc ferrite nanocatalyst (ZnFe₂O₄) as a new and efficient nanocatalyst and study of its efficacy designed for research of 7,7-dimethyl-4-phenyl-2-thioxo-2,3,4,6,7,8-hexahydro-1H-quinazolin-5-one compounds from dimedone. In incidence of an produced nanocatalyst, the aryl aldehydes were substituted with thiourea, which increases the yield in reflux by condensation, then cyclization to provide the desired product¹⁰.

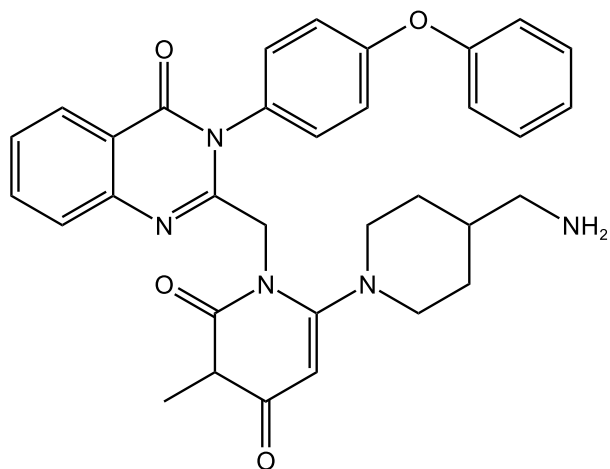


According to Tokal and Taslimi, certain quinazolinone derivatives were made using a variety of aldehydes and the compound 2-ethyl,3-aminoquinazolin-4(3H)-one. A number of the metabolic enzymes, in particular alpha-glucosidase, were tested the compounds against¹¹.

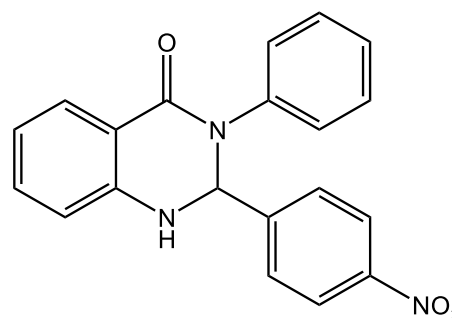


In 2020

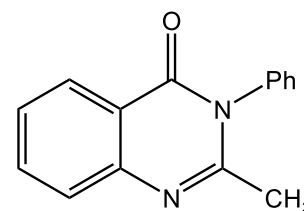
Emami and Faghih created the new quinazolinone pyrimidine and benzyl-pyrimidine hybrids and tested their ability to inhibit the dipeptidyl peptidase-4. Most effective agent was discovered to be compound, with an IC₅₀ value of 34.3-3.3 μM¹².



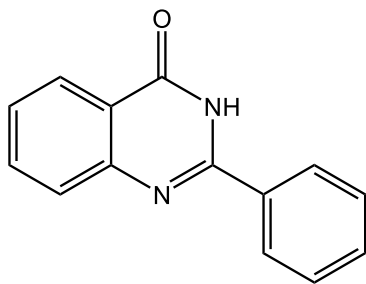
When isotoc anhydrides are combined with aryl aldehydes and 1-amines in ethanol, a green solvent, Azizi found that the KCC-1/Pr-SO₃H nanocatalyst produces di-hydroquinazolinone derivatives with high-quality yields under reflux conditions¹³.



The analysis of Grimm, Guinther, and Morgan When phosphorus trichloride is present, the 2-acetamidobenzoic acid combines with an amine to the produce 2-methyl-3-phenylquinazolin-4(3H)-one¹⁴.

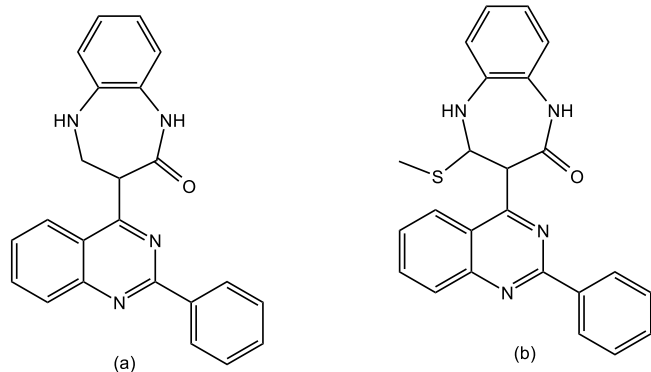


Di-tertiary-butyl peroxide (DTBP) and p-toluene sulfonic acid (p-TsOH) were used by Sharif to create 2-phenylquinazolin-4(3H)-one by reacting 2-aminobenzamide with styrene¹⁵.

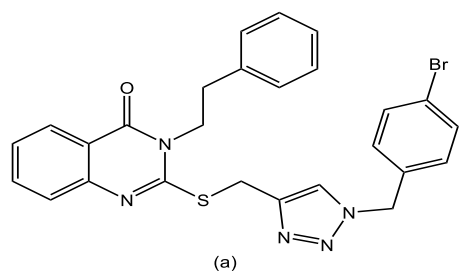
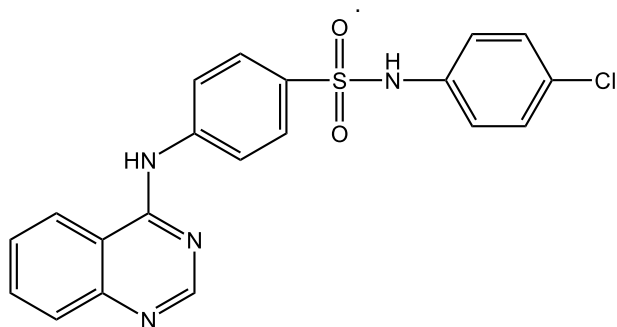


Quinazoline derivatives have antibacterial properties.

A fresh batch of 1,5-benzodiazepine analogues ornamented with quinazolines was synthesised by Misra, and their antibacterial efficacy was tested. fabricated substances (Z)-3-(2-phenylquinazolin-4-yl)-1H-benzo(b). The compounds diazepin-2(5H)-one and (E)-4-(methylthio)-3-(2-phenylquinazolin-4-yl)-1H-benzo(b). the compound 1,4-diazepin-2(5H)-one Staphylococcus aureus and Escherichia coli were the two microbes that the compound was shown to be particularly efficient against (IC₅₀ (g/mL) (a): 1 200, (ii) 200, (b): 1 200, (ii) 200)¹⁶.

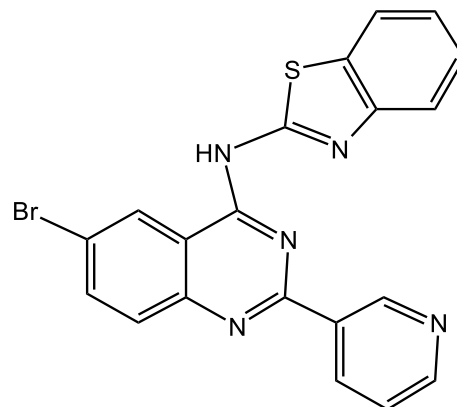


The antibacterial activity of a novel series of 4-amino-N-(phenyl)benzenesulfonamide derivatives was assessed by the Kumar. The most effective candidate against the gram-negative bacteria strain was discovered to be a chloro-derivative of the produced compound (Microbe Selected-(i)-Gram-positive Bacteria,(ii)-Gram-negative Bacteria and Activity-MIC in mg/mL, I 6.25, (ii) 3.12)¹⁷.



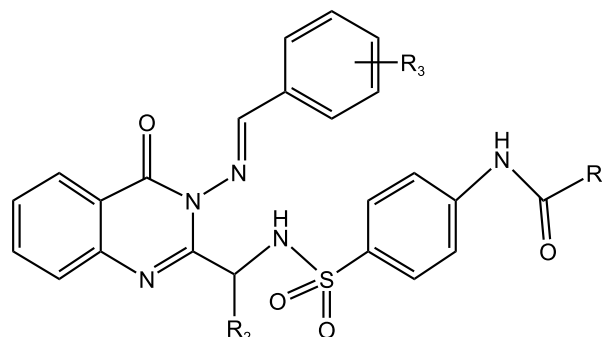
Using anti-tumor medicines based on quinazoline

HepG2, MCF-7, PC-3, HCT-116, and HeLa tumour cell lines were used to investigate the antitumor activity of produced substances. The ability of the compound to simulate cell cycle arrest in the G₂/M phase and the results demonstrated substantial EGFR inhibitory activity. A good correlation between molecular modelling findings and biological outcomes was discovered while studying the interaction of active sites. 6-Bromo-2-(pyridin-3-yl) With the initial reagent, a series of 4-substituted quinazolines was created. derivatives of 4-chloro (Activity Tested Against Cells: I EGFR, (ii) A549, (iii) MCF7, (iv) WI38, (v) PC9, (vi) HCC827)¹⁸.



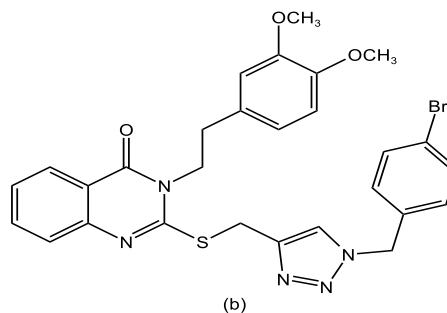
Quinazolinone's ability to the prevent malaria

Patel performed the *N*-heterocyclization of leucine-linked sulphonamides that synthesize quinazolinone- and sulphonamide-based hybrids *via* modified Grimmel's method (R₁=CH₃,R₂= X=Cl,I and R₃=4- Cl)¹⁹.



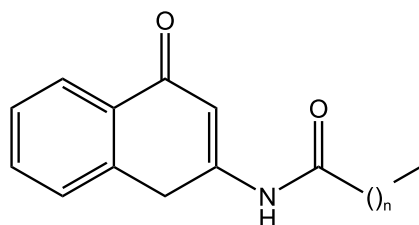
In 2019

Reported Saeedi M a series of quinazolinone-1,2,3-triazole hybrids 10a-p as potent α -glucosidase inhibitors for use as anti-diabetic agents that the exhibited more potent inhibitory activity against yeast α -glucosidase (IC₅₀ 181.0-474.5 μ M) greater than the reference drug acarbose (IC₅₀ = 750.0). These compounds' quinazolinone-1,2,3-triazoles with the 4-bromobenzyl moiety attached to the 1,2,3-triazole rings (a) and (b) showed the strongest-glucosidase inhibitor action²⁰.

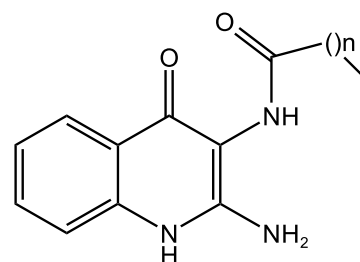


Anti-virulence activity

Espinosa-Valdes The production of biofilms was inhibited by 2-amino-4-quinolone long chain amide derivatives. The most important effective substances were those with an alkyl chain longer than 12 carbon atoms, and the generally speaking, they were more effective against *P. aeruginosa* biofilm progress



(a) n=10



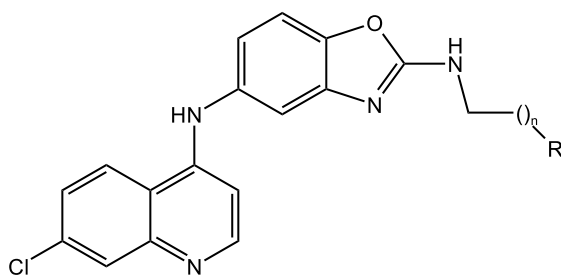
(b) n=10

than *S. aureus*. At a concentration of 20 M, the two most effective compounds (a) and (b) likewise condensed the creation of pyocyanin by between 62.6 and 68.2%. None of the investigated substances had an impact on bacterial growth, indicating that the derivatives' activity might have been modulated by QS²¹.

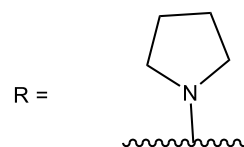
Anti-Malarial Activity

Leven provide the three compounds (a), (b), and (c) showed in vivo efficacies in a dose-dependent manner with 99.5% parasitemia reduction, with derivative (c) being the most successful. 8-Aminoquinolines Other well-known and effective

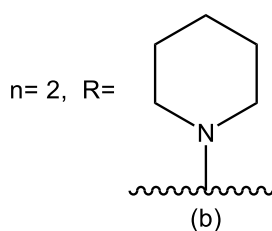
the antimalarial medications include primaquine and tefenoquine. The biotransformation of terminal amino groups into hazardous aldehydes is a shared drawback of these molecules. The synthesis of novel compounds with aminoxy and oxime-groups was done to stop this change and to preserve good antimalarial activity²².



(a) n=1

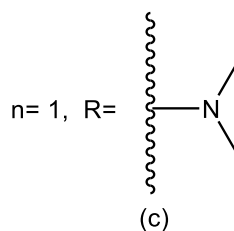


R =



n=2, R=

(b)

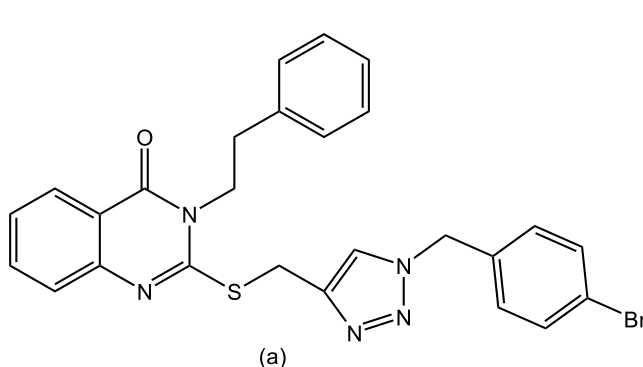


n=1, R=

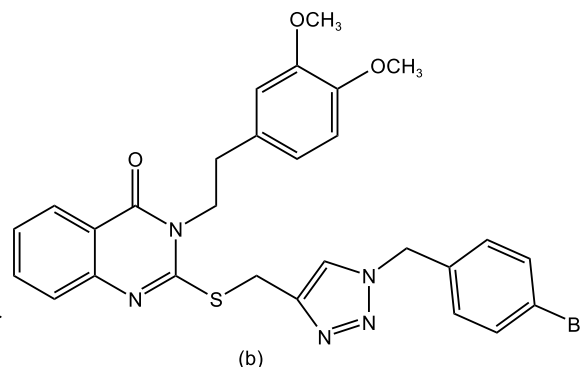
(c)

Inhibitory action of Alpha-glucosidase

As powerful -glucosidase inhibitors for use as anti-diabetic medications, Saeedi M. reported a series of quinazolinone-1,2,3-triazole hybrids 10a-p. These compounds displayed increased inhibitory action²³.



(a)

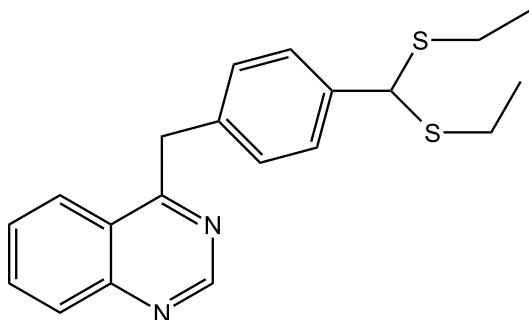


(b)

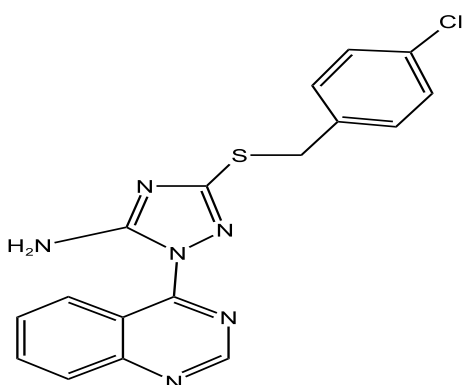
In 2018

Quinazoline derivative's antiviral properties

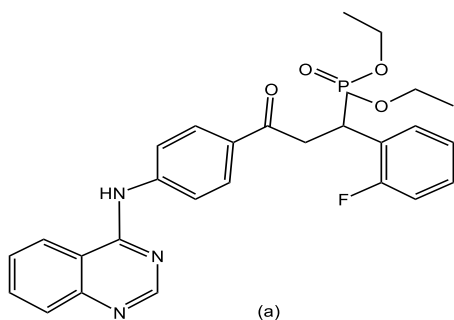
In relation to ningnanmycin, a dithioacetal moiety containing quinazoline derivatives was created as a potential antiviral drug. In the comparison to commercially available ningnanmycin quinazoline was found to have maximum therapeutic effectiveness against CMV (cucumber mosaic virus) with EC50 = 248.6 ug/mL and potato virus Y (EC50 = 350.5 g/mL)²⁴.



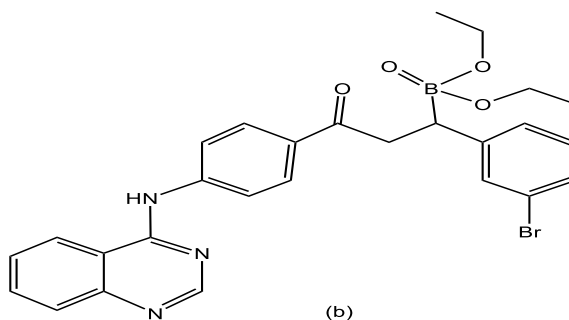
Ethyl 2-(5-amino-1-(quinazolin-4-yl)-1H-1,2,4-triazol-3-ylthio) acetate and its Compound have exhibited strong inhibitory effect the against phytopathogenic microorganisms. These substances had been EC50 values of the 93.1 ug/mL and 56.9 ug/mL, respectively, against the bacterium *Xanthomonas axonopodis* pv. Citri, outperforming the commercially available agrobactericide Bismethiazol²⁵.

**Anti-tuberculosis activity of quinazoline derivative**

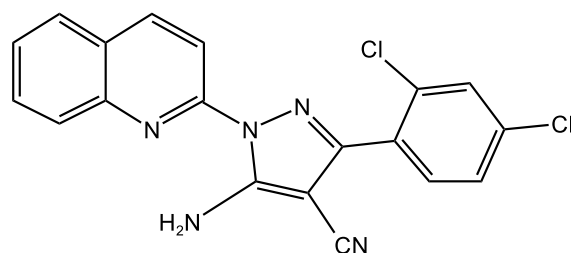
The various interaction between quinoline and pyrazole derivatives also known for their bioactivities against tuberculosis or TB, viruses, and inflammation and three different series of the antimicrobials was evaluated. Most derivatives showed pure antibacterial and antifungal properties, and compound emerged as the most promising one. Its MICs for *Shigella flexneri*, *Klebsiella pneumoniae*, *Staphylococcus epidermidis*, and *Proteus vulgaris* were in the range of ampicillin and gentamycin MICs and varied from 0.12 to 0.98 g/ml²⁶.



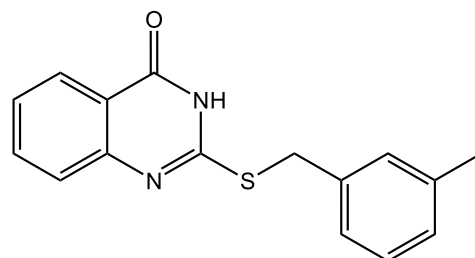
(a)



(b)

**Monoamine oxidase inhibitor activity (MAO)**

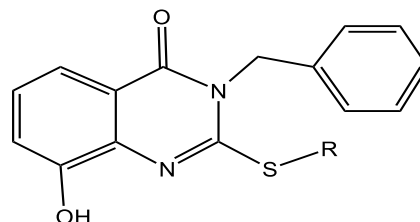
The seven quinazolinone compounds have been identified as the potent and specific MAO-B inhibitors by Qhobosheane, with the most effective inhibitor having an IC50 value of 0.142μM²⁷.



In 2017

Anti-tumor medications based on quinazoline

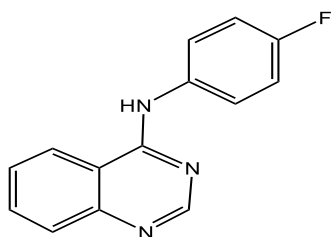
The intrinsic thioxo group of one more series of quinazoline derivatives has been hydrozinylyzed to produce matching thioethers. The mainly or most compounds are displayed demonstrated strong activity against the very tested cell-lines, with IC50 values for HeLa and MDA-MB231 cells ranging from 1.85 to 2.81 μM, respectively (Activity Tested against the Cells-HeLa, MDA-MB231 and Cytotoxicity- 1.85, 2.33 μM)²⁸.

**R=3-(Phthalimido-2-yl)propyl****Quinazoline derivatives' antiviral properties**

The synthesis of chalone-like molecules, alpha, beta-unsaturated carbonyl compounds have been 1,4-hydrophosphinylated. The cucumber mosaic virus was used as a test subject for antiviral activity. a few compounds The protective activities of the compound are equivalent to those of the commercially available medicines ningnanmyin and dufulin at 55.1% and 56.8%, respectively²⁹.

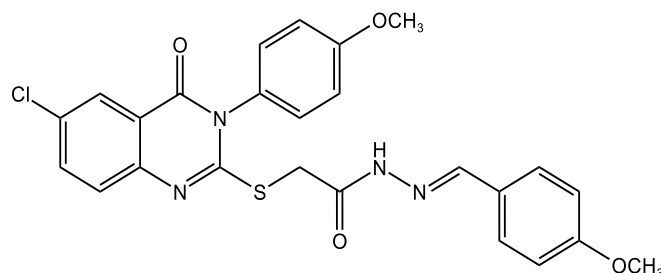
Anti-Inflammatory Effects of Quinazoline

In comparison to diclofenac, synthetic substituted pyrrolo-quinazoline derivatives were investigated for biological efficacy as anti-inflammatory agents. The created substance was discovered to be the most effective anti-inflammatory agent³⁰.



Active inhibition of thymidine synthase

According to Gazzar, a derivative of 2-mercaptoquinazolin-4(3H) is a powerful inhibitor of the DHFR enzyme in the liver of cattle ($IC_{50} = 0.01 \mu M$)³¹.

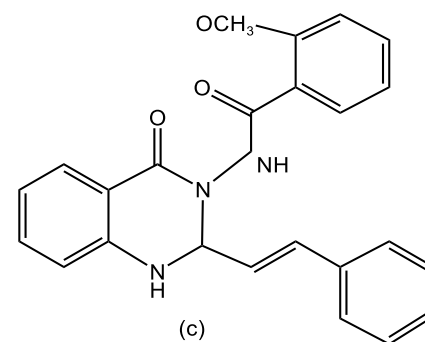
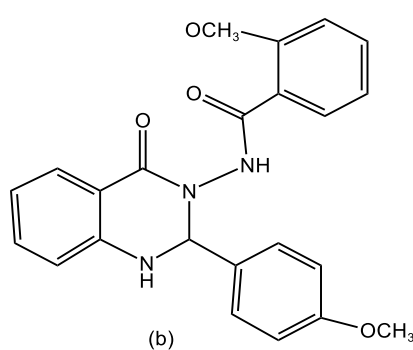
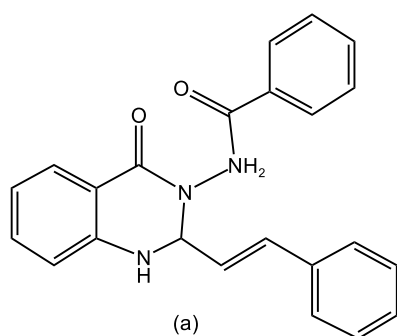


In 2016

Anti-fungal activity of quinazolinone

The quinazolinone derivatives containing 3-acrylamino motifs were screened for the antifungal activities against four

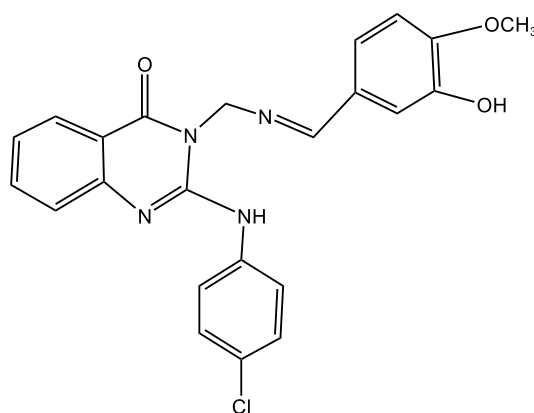
phytopathogenic fungi by minimum inhibitory concentration (MIC) method. Compounds (a),(b) and (c)) exhibited side street the activity of antifungal and substituent's play essential position in activities³².



Quinazolinone's anti-bacterial properties

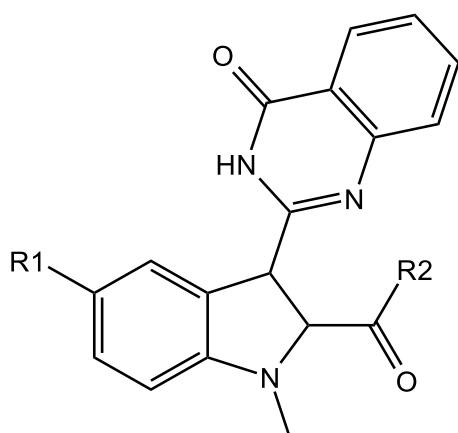
The appearance of antibiotic resistance have spawned a pressing medical need for the invention and creation of novel

types of antibacterial medicines. The necessity for the creation of novel antibiotics to treat drug-resistant bacterial strains is increasing as a result of their appearance. Quinazolinones have a wide range of the biological actions³³.



Anti-cancer activity of quinazolinone

By taking into account the ability of various indole-based amides to induce apoptosis, Gokhale created indole and quinazolinone-based amides for anti-cancer activities.



Additionally, the insertion of amide into the second position of the indole results in cytotoxicity via inhibiting histone deacetylase (HDAC). Based on these findings, quinazolinone-based indolyl amides were created and manufactured, and then their anti-cancer activity was tested.³⁴.

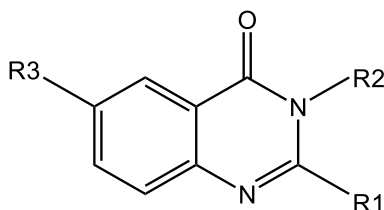
(a). R1= F, R2=3,4-difluorophenylamino

(b), R1=H, R2= cyclohexylmethylamino

Quinazolinone's anticonvulsant properties

The structure-activity relationship of the 4(3H)-quinazolinones nucleus's anticonvulsant activity showed that a methyl group at position-2 and a substituted aromatic ring at position-3 are crucial for the anticonvulsant activity of substances like methaqualone (R1 = CH₃, R2 = o-tolyl, R3 = H),

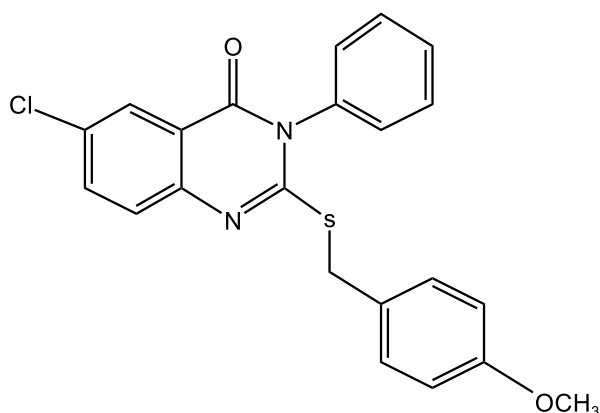
etaqualone (R1 = CH₃, R2 = 2-ethylphenyl Methaqualone is 1.5 times more effective than phenytoin sodium at preventing electroshock-induced convulsions, and at lower dosages it inhibits convulsions by acting on GABA type-A receptors, while at higher levels it has sedative and muscle-relaxing properties³⁵.



Activity as a thymidine synthase inhibitor

Several 2,3,6-substituted quinazolin-4(3H)-ones have been created. With an IC₅₀ value of 0.02 μM, compound is the most

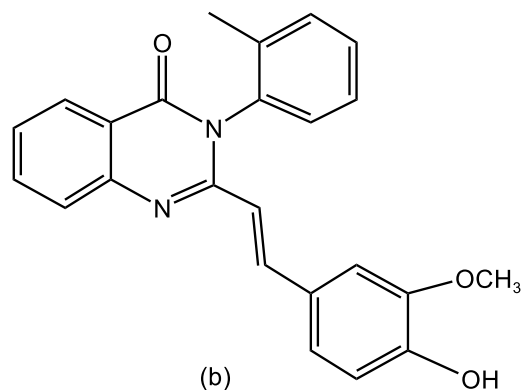
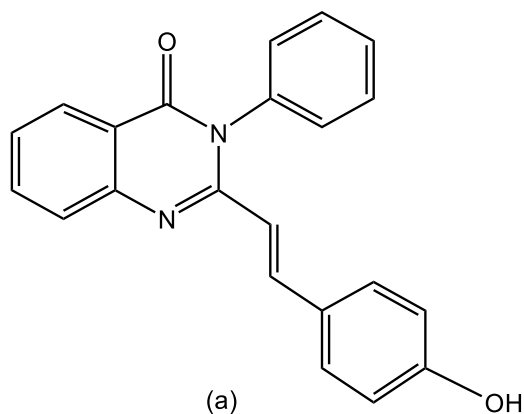
effective inhibitor of bovine liver DHFR among these substances³⁶.



In 2015

Anti-malarial activity

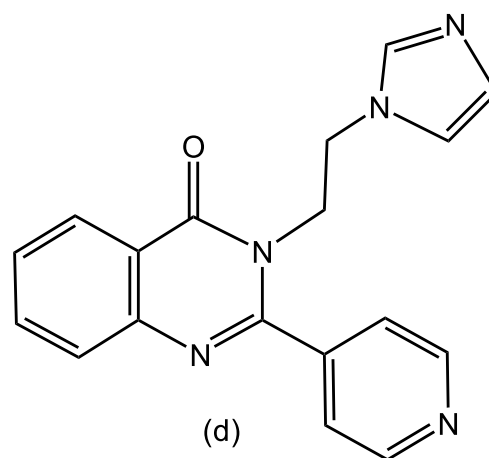
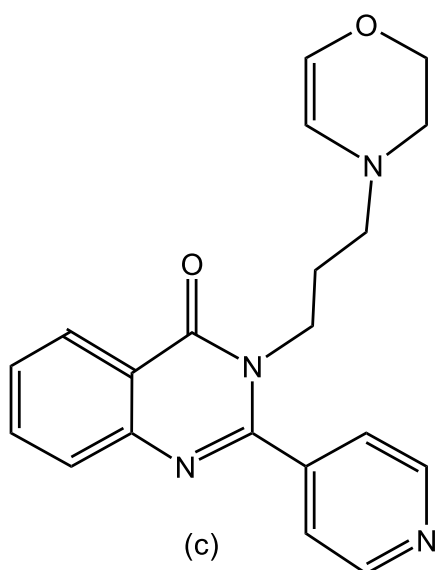
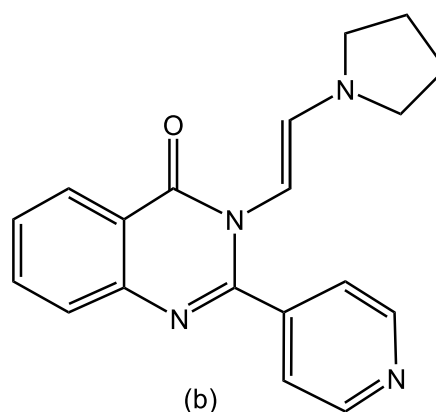
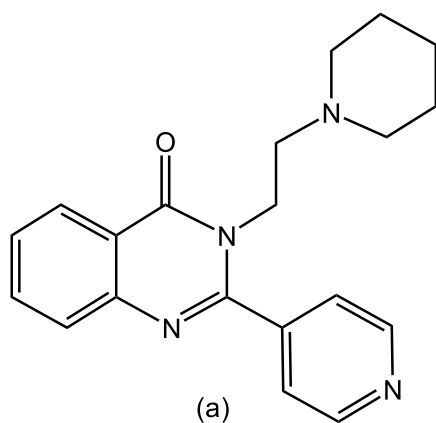
Birhan have synthesized 3-aryl2-(substituted styryl)-4(3H)-quinazolinone derivatives (a) & (b) effective anti-malarial agents³⁷.



Anti-viral activity

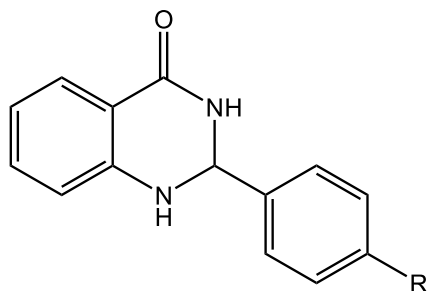
Liu reported a number of 2-pyridinyl-3-substituted-4(3H)-quinazolinones as influenza A virus antagonists. Of these derivatives, compounds (a,b,c, & d) shown robust action (IC₅₀

= 51.6-93.0 μ M) superior to that of the clinically used medication, ribavirin. furthermore, it was discovered that compound (d) might stop the spread of the influenza A virus by blocking the cellular NF- κ B pathway, however it was not as efficient as ribavirin³⁸.



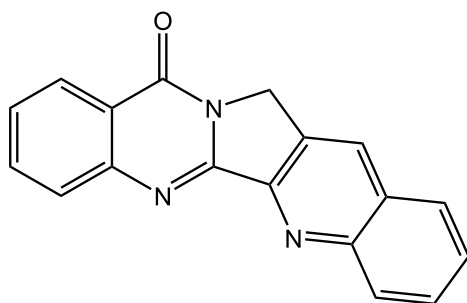
Activity that inhibits cathepsin

A series of 2,3-dihydroquinazolin-4(1H)-ones were synthesised and studied by Singh and Raghav as cathepsin inhibitors. The substances 2-(4-fluorophenyl)-2,3-dihydroquinazolin-4(1H)-one and 2-(4-chlorophenyl) The highest level of inhibition on cathepsin B was demonstrated by compounds containing 2,3-dihydroquinazolin-4(1H)-one (R = Cl). However, the most effective inhibitors of cathepsin H have been discovered to be 2,3-dihydro-2-(4-methylphenyl)quinazolin-4(1H)-one (R = Me) and 2-(4-fluorophenyl)-2,3-dihydroquinazolin-4(1H)-one (R = F)³⁹.



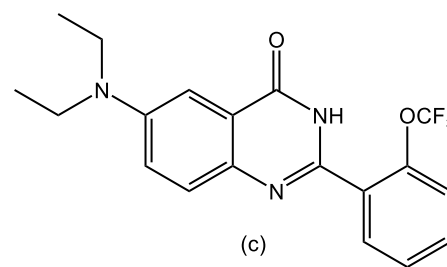
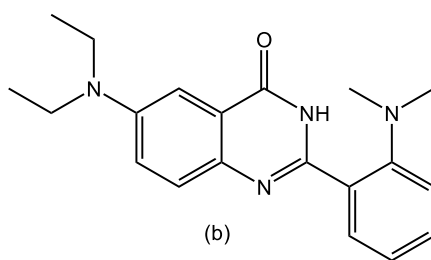
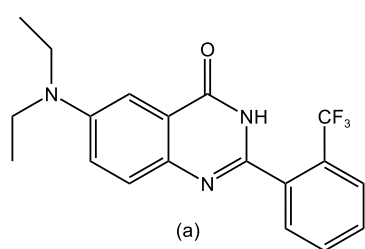
Quinazolinone's anti-cancer properties

The structural chemical shows the naturally occurring cytotoxic quinazolinones. Luotonin, a Chinese herbal remedy A chemical is a cytotoxic natural alkaloid with a pentacyclic fused-quinazolinone moiety. It was first isolated from *Peganum nigellastrum* in 1997, is used clinically as an anticancer drug, and exhibits poor human topoisomerase-I inhibitor efficacy⁴⁰.

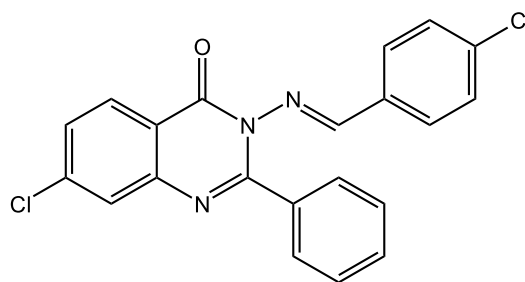


Inhibitory activity of topoisomerase

Khadka created derivatives of the 2-arylquinazolinone to test their potential as topoisomerase-targeting cytotoxic medicines

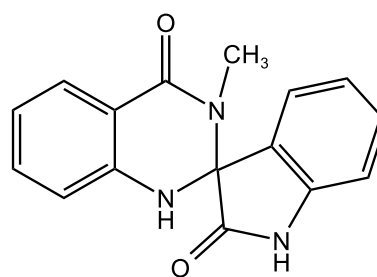


According to Malinowski, a 6-substituted quinazolinone molecule showed substantial action against the HT29 (IC₅₀ = 50.90 μM) and HCT116 (IC₅₀ = 46.00 μM) cell lines⁴¹.



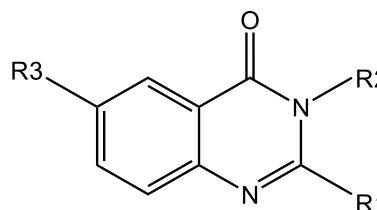
Quinazolinone's anti-inflammatory properties

Additionally, Hemalath K created a 2,3-dihydroquinazolin-4(1H)-one that was more effective than the standard medicine diclofenac sodium at preventing denaturation of bovine serum albumin (BSA)⁴².



Quinazolinone's anticonvulsant properties

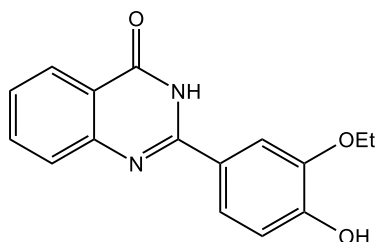
To prevent seizures caused by pentylenetetrazol, methaqualone is 10 times more effective than troxidone (R₁ = CH₃, R₂ = 2,4 = dimethylphenyl, R₃ = CH₃). It is 1.5 times more effective than phenytoin sodium as an anticonvulsant⁴³.



that are efficient, secure, and selective (topos). However, they had no effect on topo IIa while having greater potency as topo I-inhibitors⁴⁴.

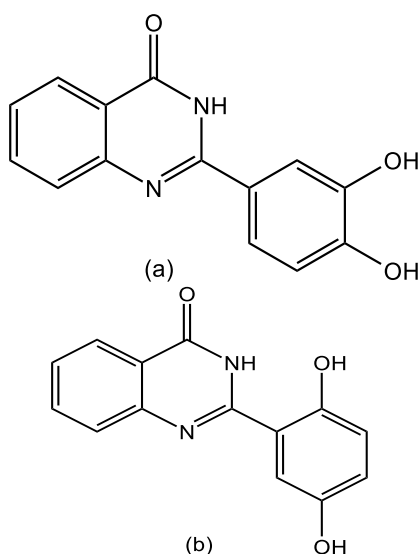
Activity as an inhibitor of Alpha-glucosidase

A quinazolinone derivative with an IC₅₀ value of 0.3 0.01 μM that Javaid described is approximately 2800 times more powerful than the reference standard medication acarbose⁴⁵.



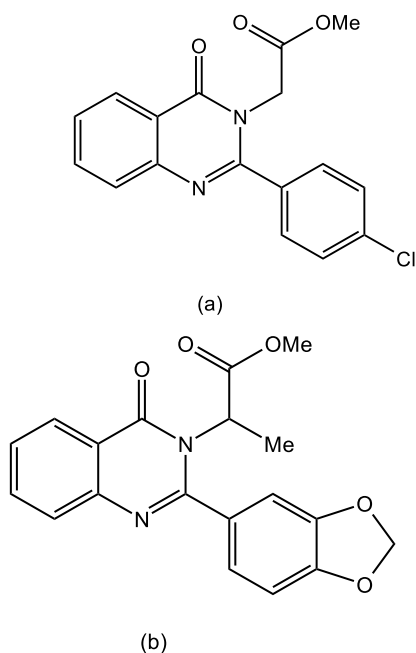
Active inhibition of thymidine synthase

Among these derivatives, compounds (a, b) were found to be the lead compounds (IC₅₀ = 42.9, 1.0 and 59.5, 1.9 μM, respectively). Javaid and coworkers reported a series of 2-arylquinazolin-4(3H)-ones as strong thymidine phosphorylase inhibitors⁴⁶.



Inhibitory action of monoamine oxidase

A series of quinazolinones carrying amino acid ester or amino acid hydrazides were reported by Khattab, and they shown competitively stronger inhibitory activity towards MAO-A than MAO-B. Against-MAO-A activity⁴⁷.



CONCLUSION

The properties of quinazoline and quinazolinone derivatives with in particular activity have been examined and described in this review. The development of more effective quinazoline and quinazolinone-based activity drugs may benefit from the medicinal chemist's understanding of this comprehensive and target-oriented knowledge.

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REFERENCES

- Hassan HY, Ismail Sherief H, Studies on synthesis of some quinazolinones bearing changed the heterocyclic moieties with expected biological activities, *Eur J Med Chem* 1991; 26:743-748 [https://doi.org/10.1016/0223-5234\(91\)90126-8](https://doi.org/10.1016/0223-5234(91)90126-8)
- Kaur P, Kaur A, Kaur R, Kaur K, Quinazolinone peptides are the new approach as potent Medicinal agents, *J Global Pharm Technol*, 2010; 2:35-39
- Wang D, Gao F, Quinazoline derivatives Synthesis and bioactivities, *Chem Cent J*, 2013; 7: 1-15 <https://doi.org/10.1186/1752-153X-7-95>
- Connolly DJ, Cusack D, Sullivan TPO, Guiry PJ, Synthesis of quinazolinones and quinazolines, *Tetrahedron*, 2005; 61(43):10153-10202 <https://doi.org/10.1016/j.tet.2005.07.010>
- Raziyeh Bakhshali-Dehkordi, Mohammad Ali Ghasemzadeh, javad safaei-ghomi, Multicomponent Preparation of Quinazolinone Derivatives, 2022; 42(3): 960-972 <https://doi.org/10.1080/10406638.2020.1759661>
- Jiangnan Yang, Zongboxie, Liang jin, Xuehua Chen, Zhanggao Le, Synthesis of quinazoline by decarboxylation of 2-aminobenzylamine and α-keto acid under visible light catalysis, *Jou of organic & biomolecular chemistry*, 2022; 20:3558-3563 <https://doi.org/10.1039/D2OB00219A>
- Wali HA, Anwar, Synthesis in vitro and in silico studies of newly functionalized quinazolinone analogs for the identification of potent αglucosidase inhibitors, *Journal of the Iranian Chemical Societ*, 2021; 3(2):1-18 <https://doi.org/10.1007/s13738-021-02159-2>
- Ansari SM, Mohammadi-Khanaposhtani, Design synthesis in vitro and in silico biological assays of the new quinazolinone-2-thio-metronidazole derivatives, *Journal of Molecular Structure*, 2021; 3(2):130889 <https://doi.org/10.1016/j.molstruc.2021.130889>
- Mahesh S, Narasaiah BP, Rostamnia S, Padhy H, Vijay V, Balaji GL, Sunflower Assisted Bio-Derived ZnO-NPs as an Efficient Nanocatalyst for Synthesis of Novel Quinazolines with Highly Antioxidant Activities, 2021; 2(3):234-245
- Rao TN, Krishnarao N, Ahmed F, Alomar SY, Albalawi F, Mani P, Aljaafari A, Parvatamma B, Arshi N, Kumar S, One-pot Synthesis of 7,7-Dimethyl-4-Phenyl-2 Thioxo-2,3,4,6,7,8-Hexahydro-1H-Quinazolin-5-Ones, Using Zinc Ferrite Nanocatalyst and its Bio Evaluation Catalysts, 2021; 11:431 <https://doi.org/10.3390/catal11040431>
- Tokalı FS, Taslımı P, Design, synthesis, molecular docking, and several metabolic enzyme inhibition properties of the novel quinazolinone and its derivatives, *Archiv der Pharmazie*, 2021; 354(5): 2000455. <https://doi.org/10.1002/ardp.202000455>
- Emami L, Faghıh Z, Design, synthesis, molecular simulation, biological activities of the novel quinazolinone-pyrimidine hybrid derivatives as dipeptidyl peptidase-4 inhibitors and anti-cancer agents, *New Journal of Chemistry*, 2020; 44(45):19515-19531. <https://doi.org/10.1039/D0NJ03774E>

- 13) Azizi S, Soleymani J, Hasanzadeh M, KCC1, Pr-SO3H, An capable Heterogeneous Catalyst for Green and One-Pot Synthesis of the 2,3-Dihydroquinazolin-4(1H)-One Nanocomposites, 2020; 6:31-40. <https://doi.org/10.1080/20550324.2019.1708634>
- 14) Bisht, AS, Negi, JS, Sharma, DK, Chemistry and activity of the quinazoline moiety, A systematic review study, Int J Pharm Chem Anal, 2020; 7:61-65. <https://doi.org/10.18231/j.ijpca.2020.009>
- 15) Sharif M, Quinazolin-4(3H)-ones, A tangible synthesis procedure via an oxidative olefin bond cleavage using the metal-catalyst free conditions, Appl Sci, 2020; 10:2815. <https://doi.org/10.3390/app10082815>
- 16) Saeedi M, Mohammadi-Khanaposhtani M, Pourrabia P, Razzaghi N, Ghadimi R, Imanparast S, Design and synthesis of novel quinazolinone-1,2,3-triazole hybrids as new anti-diabetic agents, In vitro α -glucosidase inhibition, kinetic, and docking study, Bioorganic Chemistry, 2019; 83:161-169. <https://doi.org/10.1016/j.bioorg.2018.10.023>
- 17) Sunil Kumar A, Kudva J, Lahtinen M, Peuronen A, Sadashiva R, Naral D, Synthesis, characterization, crystal structures and biological screening of the 4-amino quinazoline sulfonamide derivatives, J Mol Struct, 2019; 1190: 29- 36. <https://doi.org/10.1016/j.molstruc.2019.04.050>
- 18) Allam HA, Aly EE, Farouk AKBAW, El-Kerdawy AM, Rashwan E, Abbass SES, Design and Synthesis of some new 2,4,6-trisubstituted quinazoline and EGFR inhibitors as targeted anticancer agents, Bioorg Chem, 2020; 98:103726. <https://doi.org/10.1016/j.bioorg.2020.103726>
- 19) Patel TS, Vanparia SF, Patel UH, Dixit RB, Chudasama CJ, Patel BD, Dixit BC, Eur J Med Chem, 2020; 129:251-265. <https://doi.org/10.1016/j.ejmech.2017.02.012>
- 20) Misra A, Dwivedi J, Shukla S, Kishore D, Sharma S, Bacterial cell outflow to potential of newly synthesized quinazoline derivatives of 1,5-benzodiazepines analogue, J Heterocycl Chem, 2020; 57:1545-1558. <https://doi.org/10.1002/jhet.3879>
- 21) Espinosa Valdes MP, Borbolla Alvarez S, Delgado-Espinosa A E, Sanchez-Tejeda JF, Ceron Nava A, Quintana Romero OJ, Ariza Castolo A, Garcia Del Rio DF, Loza Mejia MA, Synthesis, in silico, and in vitro evaluation of long chain alkyl amides from 2-Amino-4-quinolone derivatives as biofilm inhibitors, Molecules 2019; 24(2):0340-390. <https://doi.org/10.3390/molecules24020327>
- 22) Leven M, Held J, Duffy S, Alves Avelar LA, Meister S, Delves M, Plouffe D, Kuna K, Tschan S, Avery VM, Winzeler EA, Mordmuller B, Kurz T, 8-aminoquinolines with an aminoxyalkyl side chain exert in vitro dual-stage antiparasitodal activity, Chem Med Chem, 2019; 14(4):501-511. <https://doi.org/10.1002/cmcd.201800691>
- 23) Saeedi M, Mohammadi Khanaposhtani M, Pourrabia P, Razzaghi N, Ghadimi R, Imanparast S, Design and synthesis of novel quinazolinone-1,2,3-triazole hybrids as new anti-diabetic agents, In vitro α -glucosidase inhibition, kinetic, and docking study, Bioorganic Chemistry, 2019; 83:161-169. <https://doi.org/10.1016/j.bioorg.2018.10.023>
- 24) Xie D, Shi J, Zhang A, Lei Z, Zu G, Fu Y, Gan X, Yin L, Song B, Hu D, Syntheses, antiviral activities and induced resistance mechanisms of novel quinazoline derivatives containing a dithioacetal moiety, Bioorg Chem, 2018; 80:433-443. <https://doi.org/10.1016/j.bioorg.2018.06.026>
- 25) Fan Z, Shi J, Bao X, Synthesis and antimicrobial evaluation of novel 1,2,4-triazole thioether derivatives bearing a quinazoline moiety, Mol Divers, 2018; 22:657-667. <https://doi.org/10.1007/s11030-018-9821-8>
- 26) El-Shehry MF, Ghorab MM, Abbas SY, Fayed EA, Shedid SA, Ammar YA Quinoline derivatives bearing pyrazole moiety: synthesis and biological evaluation as possible antibacterial and antifungal agents, Eur J Med Chem, 2018; 143:1463-1473. <https://doi.org/10.1016/j.ejmech.2017.10.046>
- 27) Qhobosheane MA, Petzer A, Petzer JP, Legoabe LJ, Synthesis and evaluation of 2-substituted 4(3H)-quinazolinone thioether derivatives as monoamine oxidase inhibitors, Bioorganic & Medicinal Chemistry, 2018; 26:5531-5537. <https://doi.org/10.1016/j.bmc.2018.09.032>
- 28) Abuelizz HA, Marzouk M, Ghabbour H, Al-Salahi R, Synthesis and anticancer activity of new quinazoline derivatives, Saudi Pharm J, 2017; 25:1047-1054. <https://doi.org/10.1016/j.jsps.2017.04.022>
- 29) Zhang GP, Pan JK, Zhang J, Wu ZX, Liu DY, Zhao L, Design, Synthesis, Antiviral Activities of Novel Phosphonate Derivatives Containing Quinazoline Based on Chalone Motif, J Heterocycl Chem, 2017; 54:2548-2555. <https://doi.org/10.1002/jhet.2849>
- 30) Bansal R, Design and Synthesis of Some Quinazoline Derivatives as Anti-Inflammatory Agents, Int J Engg Tech Sci Res, 2017; 4:61-62
- 31) El-Gazzar YI, Georgey HH, El-Messery SM, Ewida HA, Hassan GS, Raafat MM, Synthesis, biological evaluation and molecular modeling study of new (1,2,4-triazole or 1,3,4-thiadiazole)-methylthioderivatives of quinazolin-4(3H)-one as DHFR inhibitors, Bioorganic Chemistry, 2017; 72:282-292. <https://doi.org/10.1016/j.bioorg.2017.04.019>
- 32) Zhang J, Liu J, Ma Y, Ren D, Cheng P, Zhao J, One-pot synthesis and antifungal activity against plant pathogens of quinazolinone derivatives containing an amide moiety, Bioorganic, Medicinal Chemistry Letters, 2016; 6(9):2273-2277. <https://doi.org/10.1016/j.bmcl.2016.03.052>
- 33) Sugden R, Kelly R, Davies S, Combating antimicrobial resistance globally, Nature Microbiology, 2016; 1:16187-16187. <https://doi.org/10.1038/nmicrobiol.2016.187>
- 34) Gokhale N, Panathur N, Dalimba U, Nayak PG, Pai KSR, J Heterocycl Chem, 2016; 53:513-524. <https://doi.org/10.1002/jhet.2403>
- 35) Popova E, Kostov M, Kuppenova P, Effects of dopamine D1 receptor blockade on the ERG b, d waves during blockade of ionotropic GABA receptors, Eye and Vision, London, 2016; 3:32. <https://doi.org/10.1186/s40662-016-0064-4>
- 36) El-Gazzar YI, Georgey HH, El-Messery SM, Ewida HA, Hassan GS, Raafat MM, Synthesis, biological evaluation, molecular modeling study of new (1,2,4-triazole or 1,3,4-thiadiazole)-methylthioderivatives of quinazolin-4(3H)-one as DHFR inhibitors, Bioorganic Chemistry, 2017; 72:282-292. <https://doi.org/10.1016/j.bioorg.2017.04.019>
- 37) Birhan YS, Bekhit AA, Hymete A, In vivo antimalarial evaluation of some 2,3-disubstituted-4(3H)-quinazolinone derivatives, BMC Research Notes, 2015; 8:589. <https://doi.org/10.1186/s13104-015-1578-x>
- 38) Liu S, Wang W, Jiang L, Wan S, Zhang L, Yu R, 2-Pyridinyl-4(3H)-quinazolinone, A scaffold for anti-influenza a virus compounds, Chemical Biology & Drug Design, 2015; 86:1221-1225. <https://doi.org/10.1111/cbdd.12589>
- 39) Singh M, Raghav N, 2,3-Dihydroquinazolin-4(1H)-one derivatives as potential non-peptidyl inhibitors of cathepsins B and H, Bioorganic Chemistry, 2015; 59:12-22. <https://doi.org/10.1016/j.bioorg.2015.01.005>
- 40) Venkatesh R, Ramaiah MJ, Gaikwad HK, Janardhan S, Bantu R, Nagarapu L, Luotonin-a based quinazolinones cause apoptosis and senescence via HDAC inhibition and activation of tumor suppressor proteins in HeLa cells, European Journal of Medicinal Chemistry, 2015; 94:87-101. <https://doi.org/10.1016/j.ejmech.2015.02.057>
- 41) Malinowski Z, Fornal E, Nowak M, Kontek R, Gajek G, Borek B, Synthesis and biological evaluation of some amino- and sulfanyl-3H-quinazolin-4-one derivatives as potential anticancer agents, Monatshefte fuer Chemie, 2015; 146:1723-1731. <https://doi.org/10.1007/s00706-015-1508-6>
- 42) Hemalath K, Madhumith G, Vasavi CS, Munusami PJ, 2, 3-Dihydroquinazolin-4 (1H)-ones, Visible light mediated synthesis, solvatochromism, biological activity, Journal of Photochemistry and Photobiology B, Biology, 2015; 143:139-147. <https://doi.org/10.1016/j.jphotobiol.2014.12.028>
- 43) Al-Salem HS, Hegazy GH, El-Taher KF, El-Messery SM, Al-Obaid AM, El-Subbagh HI, Synthesis and anticonvulsant activity, molecular modeling study of some new hydrazinocarbothioamide, benzenesulfonohydrazide, phenacylaceto-hydrazide analogues of 4(3H)-quinazolinone, Bioorganic & Medicinal Chemistry Letters, 2015; 46:1723-1731. <https://doi.org/10.1016/j.bmcl.2015.02.057>

- 2015; 25:1490-1499.
<https://doi.org/10.1016/j.bmcl.2015.02.025>
- 44) Khadka DB, Tran GH, Shin S, Nguyen HTM, Cao HT, Zhao C, Substituted 2-arylquinazolinones, Design, synthesis, and evaluation of cytotoxicity and inhibition of topoisomerases, *European Journal of Medicinal Chemistry*, 2015;103:69-79. <https://doi.org/10.1016/j.ejmech.2015.08.040>
- 45) Javaid K, Saad SM, Rasheed S, Moin ST, Syed N, Fatima I, 2-Arylquinazolin-4(3H)-ones, A new class of α -glucosidase inhibitors, *Bioorganic & Medicinal Chemistry*, 2015; 23:7417-7421. <https://doi.org/10.1016/j.bmc.2015.10.038>
- 46) Javaid S, Saad SM, Perveen S, Khan KM, Choudhary MI, 2-Arylquinazolin-4(3H)-ones, A novel class of thymidine phosphorylase inhibitors, *Bioorganic Chemistry*, 2015; 63:142-151. <https://doi.org/10.1016/j.bioorg.2015.10.006>
- 47) Khattab SN, Haiba NS, Asal AM, Bekhit AA, Amer A, AbdelRahman HM, Synthesis and evaluation of quinazoline amino acid derivatives as mono amine oxidase (MAO) inhibitors, *Bioorganic & Medicinal Chemistry*, 2015; 23:3574-3585. <https://doi.org/10.1016/j.bmc.2015.04.021>