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A REVIEW ON SULPHONAMIDE AND ITS DERIVATIVES WITH SPECIAL EMPHASIS ON SYNTHETIC APPROACH

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ABSTRACT

Sulphonamide is a lot of significant in restorative science and furthermore in engineered natural science. As of late there are a few techniques created for the union of Sulphonamide. Sulphonamide is a significant class of heterocyclic mixtures which has wide scope of natural properties. The current work is manages a few novel combination of Sulphonamide subsidiaries. Since, Sulphonamide is the most seasoned engineered moiety that is utilized as hostile to bacterial specialist which is utilized for controlling a few bacterial illnesses. Here, likewise different sulfa tranquilizes additionally shows against bacterial action like Sulphonamide, these medications incorporates Sulphathiazole, Sulphadiazine, and so forth Sulphonamide compound are particularly significant for different natural exercises because of their numerous organic exercises, low poisonousness and cost viability. In this paper we zeroed in on survey of different engineered approaches for subbed sulphonamides subsidiaries.

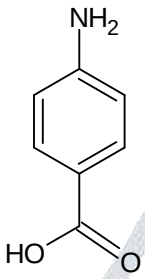
Key words: Sulphonamide, Sulphathiazole, Sulphadiazine, anti- bacterial, effectiveness,

Heterocyclic compounds, synthetic schemes.

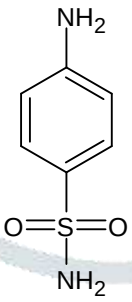
INTRODUCTION

For treating various disease there is discovery and development of new agents are reported in medicinal chemistry practices. In which various heterocyclic compounds play an important role in development of various synthetic organic compound or various therapeutics agents. Sulphonamide serve as antibacterial agent that contain sulpha drugs that are derived from sulphonamides and it is used to prevent growth of bacteria. The compound of *p*-amino benzene now known as Sulphonamide was first synthesized by Gelmo in 1908 as an intermediate study of azo dye. In 1935, a German scientist prepared a red dye i.e. 4-sulphonamide-2, 4-aminobenzene and after three years Domagk introduce the various functions of the compound the named it

Protonsil. Then the scientist named was Trefouel et.al. (1935) at Pasteur Institute discovered that the breakdown of Protonsil in *p*-amino benzene Sulphonamide, now it is known as sulphonamides. In modern chemotherapy and the concept of prodrug was utilized with the introduction of Sulphonamides. The Sulphonamides are all white colored crystalline powders, it is mostly poorly soluble in water. The solubility parameters was influenced by the nature of substituent on $-SO_2N_2$ group. The presence of free amino acid $-NH_2$ is very essential for antibacterial activity. Pharmacologically all Sulphonamides shows similar activity, only they differ from each other in solubility, rate of absorption, distribution, metabolism and excretion.



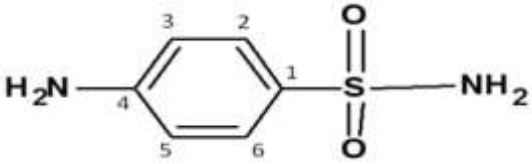
***p*-Amino benzoic acid**



Sulphonamide

Except anti-microbial and anti-bacterial activity sulphonamide moiety also shows various activities including thiazide derivatives (hydrochlorothiazide, metolazone), loop diuretics (furosemide, torsemide), sulfonylureas (glipizide, glyburide) and some COX-2 inhibitors (celecoxib) and acetazolamide.

SAR of Sulphonamide



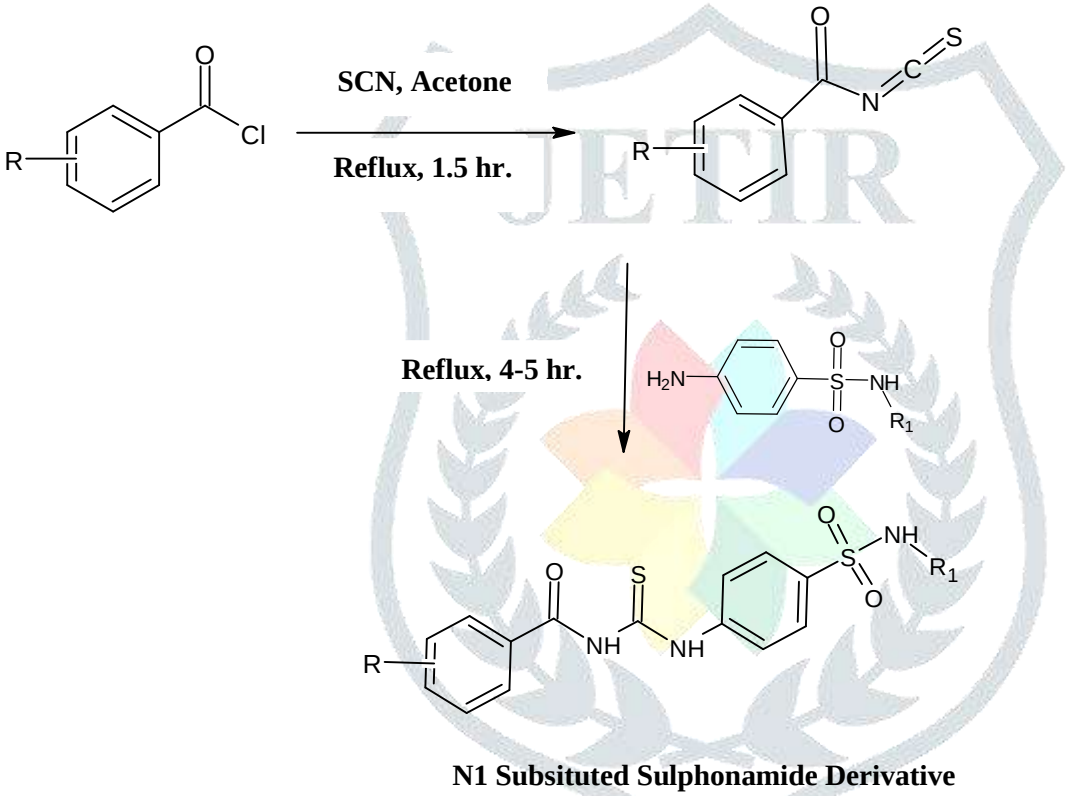
- The minimum structural requirement for the antibacterial activity is the basic Sulphonamide skeleton.
- For the activity the Amino and Sulphonyl groups are necessary and are placed in 1 and 4 position of the ring.
- The N_4 amino group can be modified into prodrug, which is then converted into free amino acids in vivo.
- Sulphur atom should be directly linked to the benzene ring.
- Replacement of benzene ring by another ring or by other substituents it decreases the activity.
- On N_1 substituted sulphonamides activity varies with the nature of substituent at the amino group with electron rich character to $-SO_2$ group. It increases the bacteriostatic activity.

Synthetic studies

By expending literature reviews various Sulphonamide derivatives was synthesized as follows:

Scheme- 1

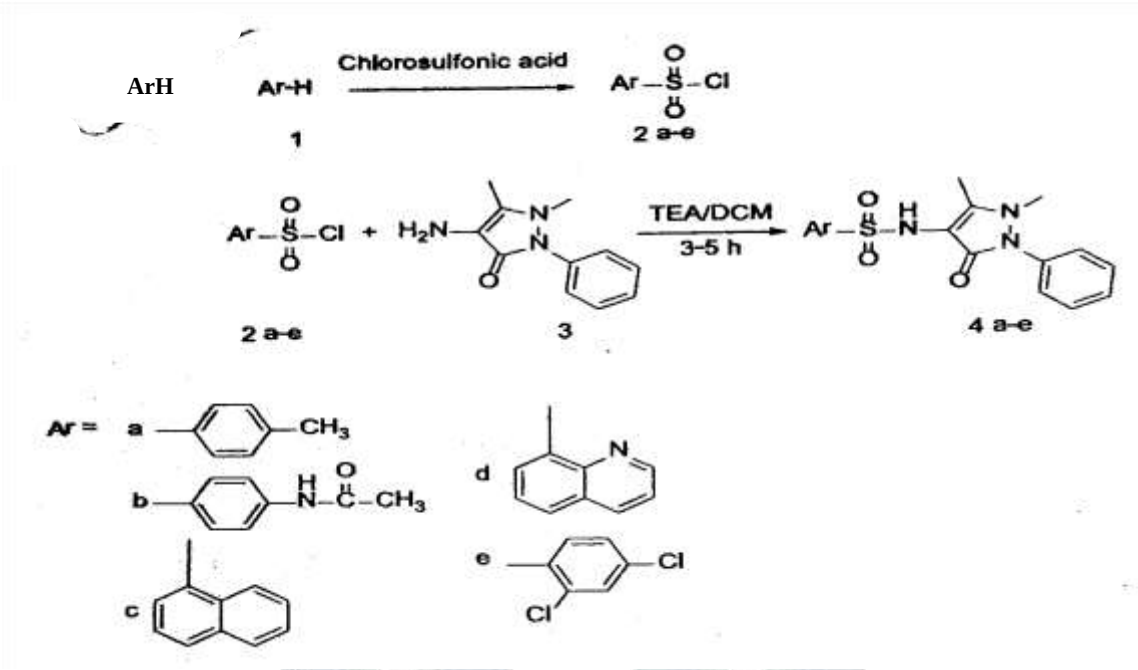
A solution of substituted benzoyl chloride (1mmol) in acetone (20ml) was added dropwise to a suspension of potassium thiocyanate (1mmol) in a acetone (30ml), and the reaction mixture was refluxed for 1.5hrs to afford substituted benzoyl isothiocyanate. The reaction was confirmed by TLC after completion of the reaction, the substituted sulphonamides (1mmol) was added and the mixture was stirred under reflux for 4-8 hrs. Upon completion of the reaction will be (checked with TLC), and resulting precipitate was collected by filtration and recrystallized from dimethyl-form amide or ethanol or water to obtained a pure product.



Scheme 1- Synthesis of Sulphonamide derivative from benzoyl chloride

Scheme- 2

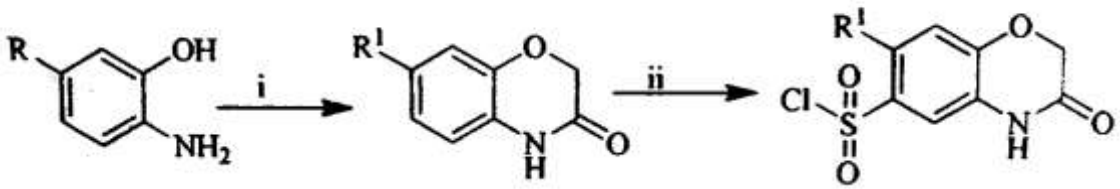
A mixture of substituted sulfonyl chlorides 2a-e (0.01), Ampyrone 3 (0.01mol) and TEA as a base in CH_2Cl_2 (20ml) was stirred at room temperature for 3-5 hrs. Further, ice-cold water was added into it and again stirred for another 20min. The product enriched with organic layer was separated and dried over $Na_2SO_4$and concentrated in vacuum. The separated crude solid was dried and recrystallized in aq. Methanol to give the pure products in 70-80% yield.



Scheme 2- Synthesis of Sulphonamide derivative from Pyrazole

Scheme- 3

Treatment of substituted o-amino phenol 3a-b with chloroacetyl chloride in presence of benzyl triethyl ammonium chloride (TEBA), afforded 2H-benzo[b][1,4] oxazin-3(4H)-one 4a-b which was further subjected to chlorosulfonylation to give compounds 5a-b.The intermediate 3-oxo-3,4-dihydro-2H-benzo[b][1,4]oxazine-6-sulfonyl chloride 5a-b was attained by the two-step synthetic route.

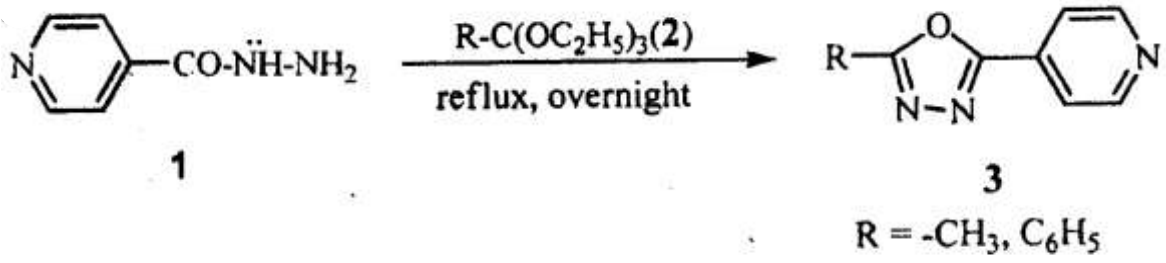


Where, R1=H, R1=CH3

scheme - i) chloroacetyl chloride, TEBA, $NaHCO_3$, $CHCl_3$, 0-55°C, 67% ii) $CISO_3H$, 0°C, 1h, 66%

Scheme-4

Synthesis of 4-(5-methyl-1-3-4oxadiazole-2-yl) pyridine. To a solution of isonicotinic acid hydrazide 25g (182.3mmol) in triethyl orthoacetate (135 ml) was added and reflux for 24h. The excess triethyl orthoacetate was distilled under reduced pressure, and residue was washed with cold ethanol. The residue was recrystallized from ethanol and obtained as brown crystals.



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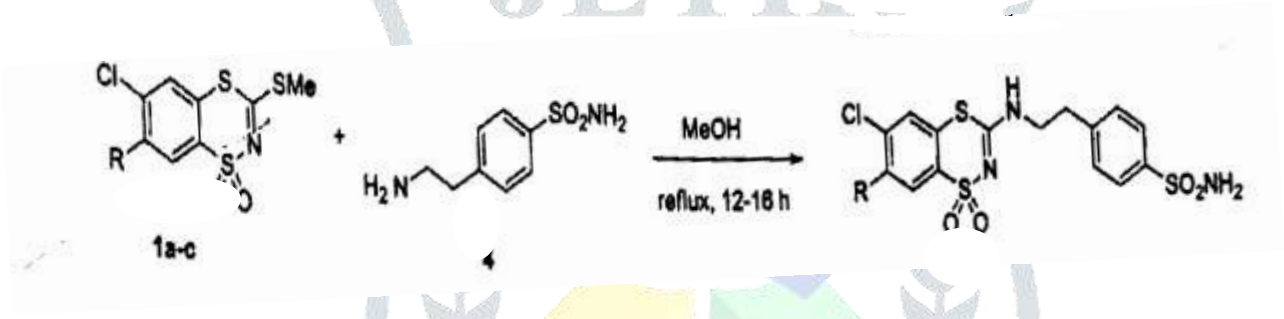
3

R = -CH_3, C_6H_5

Scheme-5

A mixture of the appropriate 3- methylthio-1, 4, 2-benzodithiazine 1, 1-dioxide and 4-(2-aminoethyl) benzenesulphonamide in anhydrous methanol 40ml, was refluxed with MeSH had ceased (12-16hrs). After cooling to room temperature, the reaction mixture was left overnight. The precipitate was collected by filtration, washed with methanol (4*2ml) and dried. In this manner the benzene Sulphonamide derivatives are obtained.



1a-c

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CONCLUSION

In the above survey we go through the different standard exploration papers from presumed diaries. From the above survey we observed that there are different manufactured ways to deal with to incorporate the sulphonamides and subbed sulphonamides subsidiaries. The Structure movement relationship studies are audited to see what the progressions in design will mean for the pharmacological action of atoms. A portion of the critical methodologies of amalgamation are evaluated which promised us a decent high return item which shows the assorted pharmacological exercises including hostile to microbial, against disease, hostile to crazy, mitigating, stimulant exercises. Thus, it is presumed that sulphonamides are finished arrangement of medication with numerous pharmacological exercises which are shown to be helpful for improvement of humanity.

REFERENCES

1.Ashutosh Kar, 2013. A Textbook of Medicinal Chemistry, CBS Publications, Fifth Revised

Edition, Pp.582-583

2. S. Kadam, K, K, 2010. A Textbook of Principles of Medicinal Chemistry, Nirali Prakashan, Volume 1, Pp.49-51.

3. Williams, V, L, S. 2011. A Textbook of Foye's Principles of Medicinal Chemistry, McGraw Hill, Seventh Edition, Pp.1073.

4. G. Dandiya, K. 2010. Textbook of Pharmacology, Vallabh Prakashan, Second Edition, Pp.163.

5. G. Gandhimati, S. 2009. A Textbook of Current Trends in Medicinal Chemistry, CBS

Publications. Pp.111-116.

6. V. Algarsamy, 2016. Textbook of Medicinal Chemistry, Elsevier Publications, Third Edition Volume 2, Pp.264.

7. Mehtap Tugrak, H. Y. L., 2020. Synthesis of Benzamide Derivatives with Thiourea-Substituted Benzenesulfonamides as Carbonic Anhydrase Inhibitors. DPHG ARCH PHARM, Pp. 1-8.

8. Andrea Scozzafava, T. A. C., 2003. Anticancer And Antiviral Sulfonamides. Current Medicinal Chemistry, Volume 10, Pp. 925-953.

9. Angela Casin, A. A. C., 2002. Sulfonamides And Sulfonylated Derivatives As Anticancer

Agents. Current Cancer Drug Targets, Volume 2, Pp. 55-75.

10. Anuradha Singh, R. R., 2017. Design, Synthesis, and Antibacterial Activities Of Novel

Heterocyclic Arylsulphonamide Derivatives. Interdiscip Sci Comput Life Sci.

11. Cyril Ronco, A. M. P. N. S. R. R., 2017. Structure Activity Relationship and Optimization Of N-(3-(2-Aminothiazol-4-Yl) Aryl)Benzenesulfonamides As Anti-Cancer Compounds Against Sensitive And. Bio Organic and Medicinal Chemistry Letter.

12. Essam M. Hussein, M. S. S., 2019. Design, Synthesis, and Biological Evaluation Of Novel N4 Substituted Sulfonamides: Acetamides Derivatives as Dihydrofolate Reductase (DHFR) Inhibitors. BMC Chemistry, Pp. 2-18.

13. Jagdish R. Badgujar, D. J., 2017. Synthesis, Antimicrobial and Antioxidant Activity Of Pyrazole Based Sulfonamide Derivatives. Indian J Microbiol.

14. Jarosław Sławinski, Z. B. K. A. D. C., 2014. Synthesis of A New Series Of N4 Substituted 4-(2-Amino ethyl) Benzenesulfonamides and Their Inhibitory Effect on Human Carbonic Anhydrase Cytosolic Isozymes I and II and Transmembrane Tumor Associated Isozymes IX And XII. European Journal of Medicinal Chemistry, Volume 84, Pp. 59-67.

15. Jonathan Wilden, J. S., 2010. The Sulfonamide Motif as A Synthetic Tool. JOURNAL OF CHEMICAL RESEARCH 2010, Pp. 541-548.

16. Krzysztof Szafranski, J. A. E., 2017. Syntheses of Novel 4-Substituted N-(5-Amino-1H, 1, 2, 4-Triazol-3-Yl) Pyridine-3-Sulfonamide Derivatives with Potential Antifungal Activity. MDPI Molecules, Volume 22, Pp. 2-17.

17. Pawe1 Zajdel, K. A. K. G. B. T. A. G. A. M. A. A. M., 2013. Antidepressant and Antipsychotic Activity of New Quinoline- And Isoquinoline Sulfonamide Analogs Of Aripiprazole Targeting Serotonin 5-HT1A/5-HT2A/5-HT7 and Dopamine D2/D3 Receptors. European Journal Of Medicinal Chemistry, Volume 60, Pp. 42-50.

18. Poonam Sharma, V. A. P. I. M. R. A., 2020. Synthesis of Sulpha Drug Based Hydroxytriazenes Derivatives: Anti-Diabetic, Antioxidant, Anti-Inflammatory Activity and Their Molecular Docking Studies. Bioorganic Chemistry, Volume 96.

19. Radhika Sharma, S., 2014. Design and Synthesis of Sulfonamide Derivatives of Pyrrolidine And Piperidine As Anti Diabetic Agents. European Journal of Medicinal Chemistry, Pp. 1-22.

20. Saidulu Konda, S. R. V. L. D., 2015. Synthesis and Antimicrobial Activity of Novel Benzocaine Sulfonamide Derivatives. Bioorganicand Medicinal Chemistry Letters. Pp. 1-9.

21. Samet Mert, Z. M. S. R., 2016. The Synthesis of Novel Pyrazole-3, 4-Dicarboxamides Bearing 5-Amino 1, 3, 4-Thiadiazole-2-Sulfonamide Moiety with Effective Inhibitory Activity Against

The Isoforms of Human Cytosolic Carbonic Anhydrase I and II. Bioorganic Chemistry, Volume 68, Pp. 64-71.

22. Yoshio Hamada, S., 2016. Novel Prodrugs with a Spontaneous Cleavable Guanidine Moiety. F. Mincione, A. Scozzafava, C.T. Supuran, The development of topically acting

carbonic anhydrase inhibitors as anti-glaucoma agents, Curr. Top. Med. Chem.

7 (2007) 849–854.

24. A. Innocenti, J. Antel, M. Wurl, A. Scozzafava, C.T. Supuran, Carbonic anhydrase

inhibitors: inhibition of human cytosolic isozyme II and mitochondrial isozyme V with a series of benzene sulfonamide derivatives, Bioorg. Med. Chem. Lett. 14 (2004) 5703–5707.

25. T.H. Maren, Carbonic anhydrase: general perspective and advances in glaucoma research, Drug Develop. Res. 10 (1987) 255–276.

26. F. Abbate, C.T. Supuran, A. Scozzafava, P. Orioli, M.T. Stubbs, G. Klebe,

Nonaromatic sulfonamide group as an ideal anchor for potent human carbonic anhydrase inhibitors: role of hydrogen-bonding networks in ligand binding and drug design, J. Med. Chem. 45 (2002) 3583–3587.

27. N. Gencer, C. Bilen, D. Demir, A. Atahan, M. Ceylan, M. Kücükislamoglu, In vitro

inhibition effect of some chalcones on erythrocyte carbonic anhydrase I and II,

Artif. Cells Nanomed. Biotechnol. 41 (2013) 384–388.

28. B.L. Wilkinson, L.F. Bornaghi, T.A. Houston, A. Innocenti, D. Vullo, C.T. Supuran,

Carbonic anhydrase inhibitors: inhibition of isozymes I, II, and IX with Triazole-linked O-glycosides of benzene sulfonamides, J. Med. Chem. 50 (2007) 1651–1657.

29. S.R. Krungkrai, N. Suraveratum, S. Rochanakij, J. Krungkrai, Characterisation of

carbonic anhydrase in Plasmodium falciparum, Int. J. Parasitol. 31 (2001) 661–668.

30. C.T. Supuran, A. Scozzafava, Carbonic anhydrases as targets for medicinal

chemistry, Bioorg. Med. Chem. 15 (2007) 4336–4350.

31. C.T. Supuran, Carbonic anhydrase inhibitors, Bioorg. Med. Chem. Lett. 20

(2010) 3467–3474.

32. A. Yildirim, U. Atmaca, A. Keskin, M. Topal, M. Celik, I. Gülcin, C.T. Supuran, NAcylsulfonamides strongly inhibit human carbonic anhydrase isoenzymes I and II, Bioorg. Med. Chem. 23 (2015) 2598–2605.

33. N. Dedeoglu, V. De Luca, S. Isik, H. Yildirim, F. Kockar, C. Capasso, C.T. Supuran,

Cloning, characterization and anion inhibition study of a b-class carbonic anhydrase from the caries producing pathogen Streptococcus mutans, Bioorg. Med. Chem. 23 (2015) 2995–3001.

34. S. Parkkila, A. Innocenti, H. Kallio, M. Hilvo, A. Scozzafava, C.T. Supuran, The

protein tyrosine kinase inhibitors imatinib and nilotinib strongly inhibit several mammalian a-carbonic anhydrase isoforms, Bioorg. Med. Chem. Lett. 19 (2009) 4102–4106.

35. Y. Akbaba, H.T. Balaydin, A. Menzek, S. Göksu, E. Sahin, D. Ekinci, Synthesis and

biological evaluation of novel bromophenol derivatives as carbonic anhydrase inhibitors, Arch. Pharm. Chem. Life Sci. 346 (2013) 447–454.

36. O. Ozensoy, M. Arslan, C.T. Supuran, Carbonic anhydrase inhibitors: purification and inhibition studies of pigeon (Columba livia var. domestica) red blood cell carbonic anhydrase with sulfonamides, J. Enzyme Inhib. Med. Chem. 26 (2011) 749–753.

37. G. Nasr, A. Cristian, M. Barboiu, D. Vullo, J.-Y. Winum, C.T. Supuran, Carbonic

anhydrase inhibitors. Inhibition of human cytosolic isoforms I and II with (reduced) Schiff's bases incorporating sulfonamide, carboxylate and carboxymethyl moieties, Bioorg. Med. Chem. 22 (2014) 2867–2874.

38. A. Thiry, J.-M. Dogné, B. Masereel, C.T. Supuran, Targeting tumor-associated

carbonic anhydrase IX in cancer therapy, Trends Pharmacol. Sci. 27 (2006) 566–573.

39. V. Alterio, A. Di Fiore, K. D'Ambrosio, C.T. Supuran, G. De Simone, Multiple binding modes of inhibitors to carbonic anhydrases: how to design specific drugs targeting 15 different isoforms?, Chem Rev. 112 (2012) 4421–4468.

40. C.T. Supuran, Carbonic anhydrases: novel therapeutic applications for inhibitors and activators, Nat. Rev. Drug Discov. 7 (2008) 168–181.

41. D. Neri, C.T. Supuran, Interfering with pH regulation in tumours as a therapeutic strategy, Nat. Rev. Drug Discov. 10 (2011) 767–777.

42. C.T. Supuran, A. Scozzafava, Carbonic anhydrase inhibitors and their

therapeutic potential, Expert Opin. Ther. Pat. 10 (2000) 575–600.

43. A.M. Marini, A. Maresca, M. Aggarwal, E. Orlandini, S. Nencetti, F. Da Settimo, S.

Salerno, F. Simorini, C. La Motta, S. Taliani, E. Nuti, A. Scozzafava, R. McKenna,

A. Rosello, C.T. Supuran, Tricyclic sulfonamides incorporating benzothiopyrano [4,3-c]pyrazole and pyridothiopyrano[4,3-c]pyrazole effectively inhibit a- and

b-carbonic anhydrase: X-ray crystallography and solution investigations on 15 isoforms, J. Med. Chem. 55 (2012) 9619–9629.

44. F. Mincione, M. Starnotti, L. Menabuoni, A. Scozzafava, A. Casini, C.T. Supuran,

Carbonic anhydrase inhibitors: 4-sulfamoyl-benzenecarboxamides and 4- chloro-3-sulfamoyl-benzenecarboxamides with strong topical antiglaucoma properties, Bioorg. Med. Chem. Lett. 11 (2001) 1787–1791.

45. G.E. Granero, M.R. Longhi, Promising complexes of acetazolamide for topical

ocular administration, Expert Opin. Drug Deliv. 7 (2010) 943–953.

46. F. Carta, C.T. Supuran, A. Scozzafava, Novel therapies for glaucoma: a patent review 2007–2011, Expert Opin. Ther. Pat. 22 (2012) 79–88.

47. F. Chimenti, R. Fioravanti, A. Bolasco, F. Manna, P. Chimenti, D. Secci, O. Befani,

P. Turini, F. Ortuso, S. Alcaro, Monoamine oxidase isoform-dependent tautomeric influence in the recognition of 3,5-diaryl pyrazole inhibitors, J. Med. Chem. 50 (2007) 425–428.

48. B.A. Bhat, S.C. Puri, M.A. Qurishi, K.L. Dhar, G.N. Qazi, Synthesis of 3,5- diphenyl-1H-pyrazoles, Synth. Comm. 35 (2005) 1135–1142.

49. S.A.H. El-Feky, Z.K. Abd El-Samii, N.A. Osman, J. Lashine, M.A. Kamel, H.K.

Thabet, Synthesis, molecular docking and anti-inflammatory screening of novel quinoline incorporated pyrazole derivatives using the Pfitzinger reaction II, Bioorg. Chem. 58 (2015) 104–116.

[28] L.-L. Xu, C.-J. Zheng, L.-P. Sun, J. Miao, H.-R. Piao, Synthesis of novel 1,3-diaryl

pyrazole derivatives bearing rhodanine-3-fatty acid moieties as potential antibacterial agents, Eur. J. Med. Chem. 48 (2012) 174–178.

50. J. Ramírez, M.V. Rodríguez, J. Quiroga, R. Abonia, M. Sortino, S.A. Zacchino, B.

Insuasty, Efficient synthesis of novel 3-aryl-5-(4-chloro-2-morpholinothiazol5-yl)-4,5-dihydro-1H-pyrazoles and their antifungal activity alone and in combination with commercial antifungal agents, Arch. Pharm. Chem. Life Sci. 347 (2014) 566–575.

51. D.C. Malvar, R.T. Ferreira, R.A. De Castro, L.L. De Castro, A.C.C. Freitas, E.A.

Costa, I.F. Florentino, J.C.M. Mafra, G.E.P. De Souza, F.A. Vanderlinde,

Antinociceptive, anti-inflammatory and antipyretic effects of 1.5-diphenyl1H-Pyrazole-3-carbohydrazide, a new heterocyclic pyrazole derivative, Life Sci. 95 (2014) 81–88.

52. I.N. Cvijetic´, M. Tanc, I.O. Juranic´, T.Z˘. Verbic´, C.T. Supuran, B.J. Drakulic´, 5-Aryl1H-pyrazole-3-carboxylic acids as selective inhibitors of human carbonic

anhydrases IX and XII, Bioorg. Med. Chem. 23 (2015) 4649–4659.

53. P. Puthiyapurayil, B. Poojary, C. Chikkanna, S.K. Buridipad, Design, synthesis

and biological evaluation of a novel series of 1,3,4-oxadiazole bearing Nmethyl-4-(trifluoromethyl)phenyl pyrazole moiety as cytotoxic agents, Eur. J. Med. Chem. 53 (2012) 203–210.

54. H. Balseven, M.M. Isgor, S. Mert, Z. Alim, S. Beydemir, S. Ok, R. Kasimogullari,

Facile synthesis and characterization of novel pyrazole-sulfonamides and their

inhibition effects on human carbonic anhydrase isoenzymes, Bioorg. Med.

Chem. 21 (2013) 21–27.

55. R. Kasimogullari, M. Bulbul, S. Mert, H. Guleryuz, Synthesis of 5-amino-1,3,4- thiadiazole-2-sulphonamide derivatives and their inhibition effects on human

carbonic anhydrase isozymes, J. Enzyme Inhib. Med. Chem. 26 (2011) 231– 237.

56. R. Kasimogullari, M. Bulbul, H. Gunhan, H. Guleryuz, Effects of new 5-amino1,3,4-thiadiazole-2-sulfonamide derivatives on human carbonic anhydraseisozymes, Bioorg. Med. Chem. 17 (2009) 3295–3301.

57. E. Sen, Z. Alim, H. Duran, M.M. Isgor, S. Beydemir, R. Kasimogullari, S. Ok,

Inhibitory effect of novel pyrazole carboxamide derivatives on human carbonic anhydrase enzyme, J. Enzyme Inhib. Med. Chem. 28 (2013) 328–336.

58. S. Mert, R. Kasimogullari, T. Ica, F. Colak, A. Altun, S. Ok, Synthesis, structure–

activity relationships, and in vitro antibacterial and antifungal activity evaluations of novel pyrazole carboxylic and dicarboxylic acid derivatives, Eur. J. Med. Chem. 78 (2014) 86–96.