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Synthesis of Thiazole and Oxazole Derivatives by Organic Clay as a Novel Method and their Biological Evaluation

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Abstract: ***An efficient synthesis of 2, 4-substituted thiazole and oxazole derivatives by condensation of substituted acetophenone with thiourea and urea respectively was carried out. All the compounds were synthesized by novel green route using three different natural red, white and black clay as a catalyst under microwave irradiation in a solvent-free condition. Synthesized compounds were characterized and evaluated for their antimicrobial activity. Most of the compounds exhibited moderate to significant activities.***

Keywords: Thiazole, Oxazole, Clay, Anti-bacterial, Anti-fungal

I. INTRODUCTION

Since the past few decades, heterocyclic chemistry has been one of the most important disciplines in organic synthesis. Heterocycles are key compounds in the development of modern pharmaceutical chemistry. Many of these compounds have emerged as active pharmaceutical ingredients in several drugs for their potential anti-inflammatory, anti-tumor, anti-hyperlipidemic, anti-hypertensive, anti-HIV infections, and several other biological properties [1]-[7]. The design of amenable synthetic approaches for new heterocyclic systems is still significant challenge [8]. One of the most important groups of five-membered heterocycles including S, N and O atoms, are thiazole and oxazole compounds. It is well known in literature that nitrogen and sulfur containing compounds are essentially used in medical purpose for the treatment of different kinds of fungal and bacterial infections [9]. Sulfur is capable of forming both σ and π bonds therefore the studies of their binding interaction with receptor moiety was also an interesting field of research during last few years [10, 11].

Thiazole is the five membered ring system having two hetero atoms (S, N) placed in heterocyclic ring at 1,3- positions. Thiazole heterocycle is a component of many natural products like the thiazole ring present in vitamin B1 serves as an electron sink. Synthetic thiazoles have also been shown to exhibit a wide range of biological activity [12]-[15] and other has found application as liquid crystal [16] and cosmetic sunscreens [17]. Oxazole is the five member ring system having two hetero atoms (O, N) placed in heterocyclic ring at 1, 3- positions. A large numbers of oxazole compounds have emerged as active pharmaceutical ingredients in several drugs for their potential as analgesics, anti-inflammatory, antimicrobial, anticancer, antidepressants, antidiabetic and antiobesity and other biological properties [18].

Classical methods of synthesis of 1, 3-thiazole involves reaction of dimethyl acetylene dicarboxylate (DMAD) with esters and amides of dithiocarboxylic acids are well known methods for preparation of five membered S, and S, N-heterocycles [19, 20]. The synthesis of thiazoles by Hantzsch process gives good yields for simple thiazoles derived from condensation of α-haloketone with thioamide [21] however for some substituted examples low yields have been reported [17]-[22]. Substituted thiazole were synthesised by using bromine [23] and iodine [9] from acetophenone and thiourea. Functionalized thiazoles were synthesized via four component reaction between acid chlorides, tetramethylthiourea, ethyl bromopyruvate and ammonium thiocyanate [24]. 1, 3 thiazolane derivatives have been synthesized using activated acetylenic compounds and thiourea derivatives [25]. Substituted oxazole derivatives were prepared from condensation of bromo trimethoxyphenyl ethanone and acetamide [26], by dehydration of 2- acylaminoketones [27], by reacting with aldehyde and TosMIC [28], by condensation of aldehyde and hippuric acid in dry acetic anhydride catalyzed by acetate anion [29], boron-catalyzed arylthiooxygination of N-allylamide [30]-[32].

Green chemistry move towards hold out significant potential not only for reduction of by products, waste produced, and lowering of energy but also in the expansion of new methodologies using existing technologies [33]. Heterogeneous catalysis is crucial to chemical technology, and clays in particular are finding increasing applications as catalysts [34]. The challenge in chemistry to develop practical processes, reaction media, conditions and/or utility of materials based on the idea of green chemistry is one of the most important issues in the scientific community. Microwave-assisted organic synthesis (MAOS) has emerged as an efficient and

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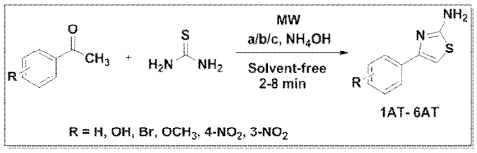
powerful tool and often leads to simple protocols, short processing times, increased product yields, energy savings [35] and lower costs, thereby enabling environmentally friendly processes [36]. As part of our current studies on the development of new routes in heterocyclic synthesis [37]-[40]. We report an efficient synthetic route to 2, 4-substituted thiazoles, oxazole derivatives and evaluate them for their antimicrobial potential.

II. EXPERIMENTAL

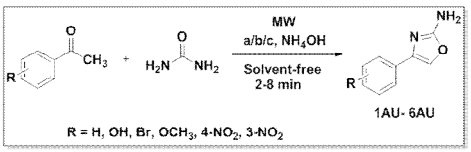
Reactions were monitored by thin layer chromatography on 0.2 mm silica gel F-252 (Merck) plates. All chemicals were obtained from Aldrich Chemicals. All solid components were employed as grained powders. Natural red, white and black clay used as a catalyst. Melting points were measured in open capillary tubes and are uncorrected. Infrared spectral studies were carried out using KBr discs on a Perkin Elmer FTIR/4000 spectrophotometer. ^{1}H NMR and ^{13}C spectra were recorded in DMSO-d6 on Bruker Advance II 400 NMR spectrometer. All products were characterized by FT-IR, ^{1}H NMR, ^{13}C NMR and by comparison of physical characteristics with authentic samples.

A. Procedure For Synthesis Of Thiazole And Oxazole Derivatives

A mixture of substituted acetophenone (0.01mol), thiourea/ urea (0.02 mol) and red clay (a)/white clay (b)/black clay (c) as a catalyst (0.5g) was subjected to microwave irradiation for appropriate time without solvent. Completion of reaction was checked by TLC 7:3 (Pet ether: Ethyl acetate). A reaction mixture was cooled to room temperature. Water was added to the reaction mixture and was heated until most of the solid gone into the solution. Reaction mixture was filtered when it was hot, filtrate was cooled and spent catalysts were collected and. Filtrate was made alkaline (pH 8-9) with ammonium hydroxide to separate the product. The product was filtered, washed with water and dried. All products were characterized by FT-IR, ^{1}H NMR, ^{13}C NMR spectroscopy. Physical properties of thiazole (Scheme 1) and oxazole (Scheme 2) compounds as shown in Table I and Table II.



Scheme



Scheme 2

Table I

Physical data of Thiazole compounds

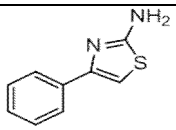
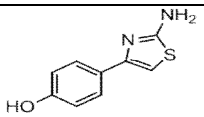
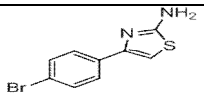
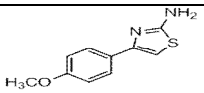
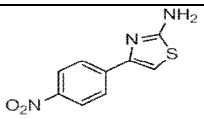
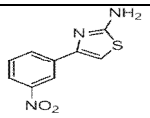
Code	Product	Red clay(a)	Time (min)	White clay (b)	Time (min)	Black clay (c)	Time (min)	M.P. (˚C)
1AT		71	2	58	3	52	4	146-148
2AT		84	3	75	5	49	3	215-218
3AT		58	4	51	5	56	4	183-186
4AT		66	2	37	3	60	2	206-208
5AT		40	4	-------		-------		280-283
6AT		65	5	----	----	----	----	176-179

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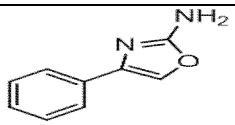
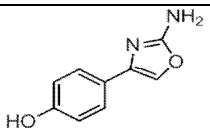
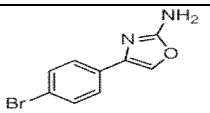
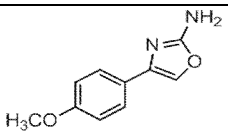
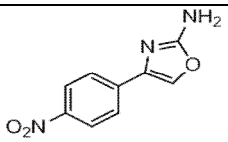
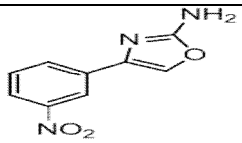
Table II
Physical data of Oxazole compounds

Code	Product	Red clay (a)	Time (min)	White clay (b)	Time (min)	Black clay(c)	Time (min)	M.P.(˚C)
7AU		89	4	64	3	73	4	113-116
8AU		62	2	76	4	70	4	103-106
9AU		58	6	51	7	73	6	269-272
10AU		----		----		-----		
11AU		81	5	56	7	63	4	281-283
12AU		------		------		-----		

B. Biological Screening Of Synthesized Thiazole And Oxazole Derivatives

All the synthesized compounds were subjected to antimicrobial screening at a concentration of 10 mg/ml involving one Gram – ve bacteria (*Escherichia coli*); one Gram + ve bacteria (*Staphylococcus aureus*) and two fungal strains (*A. niger* and *C. albicans*) using Chloramphenicol as a standard for bacteria and Ketoconazole for fungi at the same concentration. Antimicrobial activity was studied using agar cup diffusion method. Samples were prepared as 10 mg/mL stock in Dimethyl sulfoxide. The samples were stored at RT till further analysis.

1) *Antimicrobial activity:* The bacterial and fungal cultures were grown in Luria Bertani and Potato Dextrose broth for 24h and 48h respectively and then used for the study. The optical densities of the culture were adjusted using 0.5 McFarland standard (106 cfu/mL) and then taken ahead for checking the antimicrobial activity using agar cup diffusion method. Each plate contained four samples- a positive control (Chloramphenicol for bacteria) (Ketoconazole for fungi), a negative control (DMSO) and two samples of a single concentration. 0.1mL volume of each sample was loaded into the wells and the plates were incubated at 37°C for 24h for bacteria and 48h for fungal growth. The zone of inhibition was further measured in mm. Results obtained are shown in Table III.

C. Spectral analysis of thiazole and oxazole compounds

1) *Compound 1AT:* FT-IR (KBr, cm^{-1}): 3245, 3292, 3116, 2926, 1627, 1605, 1315; ^{1}H NMR (DMSO, δ ppm): 7.51-7.48 (m, 5H), 6.6 (s, 1H), 3.95 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 172, 145, 128, 126, 123, 114, 112
2) *Compound 2AT:* FT-IR (KBr, cm^{-1}): 3463, 3255, 3228, 3093, 1636, 1456, 1327, 1296, 1176; ^{1}H NMR (DMSO, δ ppm): 7.29-7.32 (m, 4H), 9.2 (s, 1H, D_2O exchangeable), 6.9(s, 1H), 4.5 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 174, 141, 137, 130, 127, 114, 103

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3) *Compound 3AT:* FT-IR (KBr, cm^{-1}): 3353, 3312, 3123, 1638, 1587, 1268, 1093, 820; ^{1}H NMR (DMSO, δ ppm): 6.34-6.37 (m, 4H), 7.21(s, 1H), 3.96 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 171, 143, 135, 130, 129, 119, 117
4) *Compound 4AT:* FT-IR (KBr, cm^{-1}): 3373, 3246, 3054, 1632, 1504, 1336, 1253, 1103; ^{1}H NMR (DMSO, δ ppm): 7.25-7.29 (m, 4H), 6.30(s, 1H), 4.24 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 56, 168, 157, 130, 129, 123, 126, 121
5) *Compound 5AT:* FT-IR (KBr, cm^{-1}): 3367, 3265, 3169, 1640, 1590, 1387, 1094; ^{1}H NMR (DMSO, δ ppm): 6.65-7.01 (m, 4H), 7.41(s, 1H), 3.92 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 170, 135, 128, 124, 121, 119, 117
6) *Compound 6AT:* FT-IR (KBr, cm^{-1}): 3429, 3284, 3114, 1638, 1536, 1390, 1039; ^{1}H NMR (DMSO, δ ppm): 6.34-6.38 (m, 4H), 7.21(s, 1H), 3.83 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 178, 167, 150, 148, 136, 134, 131, 123, 112
7) *Compound 7AU:* FT-IR (KBr, cm^{-1}): 3428, 2970, 1620, 1358, 1118, 789; ^{1}H NMR, (DMSO, δ ppm): 7.52-7.45 (m, 2H), 7.30-7.25 (m, 2H), 7.08 (m, 1H), 6.71 (s, 1H), 5.10 (s, 2H); ^{13}C NMR, (DMSO, δ ppm): 164, 142, 139, 131, 130, 127, 125
8) *Compound 8AU:* FT-IR (KBr, cm^{-1}): 3476, 2940, 1611, 1414, 1350, 1290, 1174; ^{1}H NMR (DMSO, δ ppm) : 6.85-6.53 (d, 2H), 7.43-7.49 (d, 2H), 7.41 (s, 1H), 9.31 (s, 1H), 4.8 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 169, 160, 142, 138, 128, 124, 115
9) *Compound 9AU:* FT-IR (KBr, cm^{-1}): 3471, 2937, 1627, 1582, 1411, 1354, 1118, 1020; ^{1}H NMR, (DMSO, δ ppm): 6.60-6.65 (d, 2H), 7.75-7.78 (d, 2H), 7.01 (s, 1H), 3.90 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 175, 143, 140, 133, 130, 127, 124
10) *Compound 11AU:* FT-IR (KBr, cm^{-1}): 3411, 3291, 3125, 1628, 1591, 1351, 1113, 1023, 809; ^{1}H NMR (DMSO, δ ppm): 8.39-8.30 (d, 2H), 8.05-7.94 (d, 2H), 7.50 (s, 1H), 3.86 (s, 2H); ^{13}C NMR (DMSO, δ ppm): 170, 150, 141, 138, 137, 127, 125

III.RESULT AND DISCUSSION

In this paper, we have developed the novel method for the synthesis of 2, 4-substituted thiazole and oxazole compounds. In many papers they have used bromine or iodine as a catalyst for this synthesis. Here, we had used natural red, white and black clays as a heterogenous catalyst. Clays are cheap, non-toxic and reusable.

A series of substituted phenyl thiazole (1AT-6AT) and oxazole (1AU-6AU) compounds were synthesized by reaction of substituted acetophenone and thiourea/urea with red clay, white clay and black clay in microwave oven (400W) in solvent-free condition. Compounds 1AT and 2AT obtained in excellent yield with red clay as catalyst as compared to white and black clay. Compound 3AT obtained in good yield with all three red, white and black clay as a catalyst. Compound 4AT obtained in good yield with red and black clay as compared to white clay as a catalyst. Compound 5AT, 6AT obtained in moderate and good yield respectively only with red clay as a catalyst.

Compound 1AU obtained in excellent yield with red clay as catalyst than white and black clay. Compound 2AU obtained in very good yield with white clay as a catalyst than red and black clay. Compound 3AU obtained in good yield with black clay as a catalyst than red clay and white clay. Compound 5AU obtained in excellent yield with red clay as a catalyst than white and black clay. Compounds 4AU, 6AU, 10AU, 12AU obtained in negligible yield. Synthesized compounds were screened for anti-microbial activity.

Table III
Antimicrobial Activity of synthesized thiazole and oxazole derivatives

Samples	Zone of inhibition in mm							
	P. C.	S.aureus +ve bacteria	P. C.	E.coli -ve bacteria	P. C.	A.niger Fungi	P. C.	C.albicans Fungi
1ATa	10	10	15	10	22	10	15	13
2ATa	10	14	15	13	21	10	13	16
3ATb	10	10	15	10	22	10	15	14
4ATa	10	12	15	12	22	14	14	14
6ATa	10	10	15	12	21	10	13	13
7AUa	10	10	15	10	22	10	14	10
8AUa	10	15	15	13	24	10	15	16
9AUa	10	10	15	10	24	10	15	12
11AUa	10	16	15	16	20	20	16	10

P.C.- Positive control

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All the synthesized compounds showed good antimicrobial activity. From the **Table III**, we can see that hydroxy, methoxy substituted thiazole derivatives show significant activity while bromo, nitro, hydrogen substituted thiazole derivatives show good activity against *S.aureus.* In case of oxazole derivatives, hydroxy, 4-nitro substituted oxazole derivatives show significant activity while hydrogen, bromo, methoxy, 3- nitro substituted oxazole derivatives show good activity against *S.aureus*. Both thiazole and oxazole substituted derivatives show moderate activity against *E.coli* except compound **11AUa** which show good activity. All the compounds show moderate activity against *A.niger*. Compound **2ATa** containing hydroxy substituent show significant activity while other compounds show good activity against *C.albicans.*

IV. CONCLUSION

In conclusion we have synthesized 2, 4-substituted thiazole and oxazole compounds from substituted acetophenone and thiourea/urea respectively by using three red, white and black clay as a catalyst. The attractive features of this protocol are simple procedure, cleaner reaction, satisfactory yields of products, simple reactions, isolation of products as well as its compliance with the green chemistry protocols which makes it useful protocol for the synthesis of these classes of compounds. Synthesized compounds were tested for antimicrobial activity. All compounds were shown good to significant activity against standard used.

V. ACKNOWLEDGMENT

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REFERENCES

[1] C. Papadopoulou, A. Geronikaki, D. Hadjipavlou-Litina, “Synthesis and biological evaluation of new thiazolyl/ benzothiazolyl-amides derivatives,” II Farmaco, vol. 60, pp-969-973, 2005.
[2] S. Miwatashi, Y. Arikawa, E. Kotani, et al., “Novel Inhibitor of p38 MAP kinase as an anti-TNF-drug: discovery of N-[4-[2- ethyl-4-(3-methylphenyl)-1,3-thiazol-5- yl]-2-pyridyl]benzamide (TAK-715) as a potent and orally active anti-rheumatoid arthritis agent,” J. Med. Chem., vol. 48, pp-5966-5979, 2005.
[3] Y. Kumar, R. Green, K.Z. Borysko, et al., “Synthesis of 2, 4-disubstituted thiazoles and selenazoles as potential antitumor and antifilarial agents. 1- Methyl 4-(isothiocyanatomethyl) thiazole-2-carbamates-selenazole-2-carbamates, and related derivatives,” J. Med. Chem., vol. 36, pp- 3843-3848, 1993.
[4] R. Pereira, C. Gaudon, B. Iglesias, P. Germain., “Synthesis of the PPAR-selective agonist GW501516 and C4-thiazole- substituted analogs,” Bioorg. Med. Chem. Lett., vol. 16, pp- 49-54, 2006.
[5] Y. Tsurumi, S. Yoshimura, K. Hayashi, S. Takase, M. Okuhara , “WS75624 A and B, new endothelin converting enzyme inhibitors isolated from Saccharothrix sp. No. 75624,” J. Antibiot.,vol.48, pp- 1073-1075, 1995.
[6] D. S. Millan, R.H. Prager, C. Brand, P.H. Hart, “The synthesis and activity of oxazole and thiazole analogues of urocanic acid,” Tetrahedron, vol. 56, pp- 811-816, 2000.
[7] W.L. Wang, D.Y. Yao, M. Gu, et al., “Synthesis and biological evaluation of novel bisheterocycle-containing compounds as potential anti-influenza virus agents,” Bioorg. Med. Chem. Lett., vol. 15, pp-5284-5287, 2005.
[8] Z. Hossaini, F. Rostami-Charati, M. E. Moghadam, F. Moghaddasi-Kochaksaraee, “Expeditious solvent-free synthesis of 1, 3 thiazolanes via multicomponent reactions,” Chi. Chem. Lett. Vol. 25(5), pp-794-796, 2014.
[9] A. K. Prajapati, V. P. Modi, “Synthesis and biological evaluation of some substituted aminothiazole derivatives,” J. Chil. Chem. Soc., vol. 55, 2010 Nº 2.
[10] G. Barone, M. C. Ramusino, R. Barbieri, G. L. Manna, “THEOCHEM,” J. Mol. Struct., vol. 469 pp-143, 1999.
[11] R. Kant, K. Singhal, S. K. Shukla, K. Chandrashekar, A. K. Saxena, A. Ranjan, P. Raj, “Phosphorus, sulfur and silicon” vol.183, pp-2029-2039, 2008.
[12] T. Eicher, S. Hauptmann, “The Chemistry of Heterocycles: Structure, Reactions, Syntheses, and Applications,” 2nd Ed., Weinheim: Wiley-VCH, 2003.
[13] L. D. Quin, J. A. Tyrell, “Fundamentals of Heterocyclic Chemistry: Importance in Nature and in the Synthesis of Pharmaceuticals,” Hoboken: Wiley and Sons, 2010.
[14] B. Chen, W. Heal, “Comp. Heterocyclic Chem. III,” New York: Pergamon. Vol. 4, pp-635, 2008.
[15] Y. J. Wu, B. V. Yang, “A delivery system targeting bone formation surfaces to facilitate RNAi-based anabolic therapy,” Heterocyclic Chem., vol. 29, pp-307-314, 2012.
[16] A. A. Kiryanov, P. Sampson, A. J. Seed, “Synthesis of 2-alkoxy-substituted thiophenes, 1,3-thiazoles, and related S- heterocycles via Lawesson's reagent-mediated cyclization under microwave irradiation: applications for liquid crystal synthesis,” J. Org. Chem., vol. 66 (23), pp- 7925-7929, 2001.
[17] T. Bach, S. Heuser, “Synthesis of 2-(o-hydroxyaryl)-4-arylthiazoles by regioselective Pd(0) catalyzed cross-coupling,” Tetrahedron Lett., vol. 41, pp- 1707-1710, 2000.
[18] S. Joshi, A. S. Bisht, D. Juyal, “Systematic scientific study of 1, 3-oxazole derivatives as a useful lead for pharmaceuticals: A review,” The Pharma Innovation Journal, vol. 6 (1), pp-109-111, 2017.
[19] G. H. Elgemeie, S. H. Sayed, “Synthesis and chemistry of dithiols,” Synthesis, vol. 12, pp- 1747-1771, 2001.
[20] V. S. Berseneva, A. V. Tkachev, Yu.Yu. Morzherin, W. Dehaen, I. Luyten, S. Toppet, V. Bakulev, J. Chem. Soc. Perkin Trans I. 15 (1998) 2133-2136.
[21] R. H. Wiley, D. C. England, L. C. Behr, “Organic Reactions,” John Wiley, vol. 6, pp-367, 1951.
[22] J. S. Carter, D. J. Rogier, M. J. Graneto, K. Seibert, C. M. Koboldt, Y. Zhang, J. J. Talley, “Design and synthesis of sulfonyl substituted 4,5-diarylthiazoles as a selective cyclooxygenase -2 inhibitors,” Biorg. Med. Chem. Lett., vol. 9, pp- 1167, 1999.
[23] R. Mishra, I. Tomer, Priyanka, N. K. Sharma, K. K. Jha, “Synthesis and antimicrobial evaluation of some novel thiazole derivatives,” Der Pharmacia Sinica, vol. 3 (3), pp-361-366, 2012.

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[24] I. Yavari, Z. Hossaini, S. Seyfi, F. Shirgahi-Talari, "Efficient Synthesis of Functionalized Thiazoles from Acid Chlorides, Tetramethylthiourea, Ethyl Bromopyruvate, and Ammonium Thiocyanate," Helv. Chim. Acta. , vol. 91, pp-1177-1180, 2008.
[25] A. Doregiraee, E. T. Kermani, H. Khabazzadeh, B. Pouramiri, "Synthesis of new 1,3–thiazole derivatives; using 1- 4(carbamoylphenyl)-3-methylthiourea and 1-methyl-3-(quinolin-8-yl) thiourea as starting materials," J. Chil. Chem. Soc.,vol. 60, Nº 3, pp- 3021-3023, 2015.
[26] R. Romagnoli, P. G. Baraldi, F. Prencipe, P. Oliva, S. Baraldi, et al, "Synthesis and Biological Evaluation of 2-Methyl-4,5- Disubstituted Oxazoles as a Novel Class of Highly Potent Antitubulin Agents," Scientific Reports, vol. 7, pp-1-19, 46356.
[27] R. K. Singh, A. Bhatt, R. Kant, P. K. Chauhan, "Design and Synthesis of some Novel Oxazole Derivatives and their Biomedicinal Efficacy," Journal of Chemistry and Biology Interface 6th ed., vol. 4, pp- 263-269, 2016.
[28] M. R. Reddy, Reddy G. N. Reddy, U. Mehmood, I. A. Hussein, S. U. Rahman, "Copper (II) triflate catalysed synthesis of fragment 2, 4-disubstituted oxazoles from α-Diazoketones," vol. 47, A-F 2015.
[29] A. K. Shakya, A. Kaur, B. O. Al-Najja, R. R. Naik, Molecular Modeling, "Synthesis, Characterization and Pharmacological Evaluation of Benzo[d]Oxazole Derivatives as Non-steroidal Anti-inflammatory agents," Saudi Pharmaceutical Journal, pp-1-9, 2015.
[30] I. J. Turchi, "Review on Oxazoles," John Wiley and Sons, pp-18-20, 1986.
[31] S. Bala, M. Saini, S. Kamboj, "Methods for synthesis of Oxazolones: A Review," International Journal of Chem. Tech., Research vol. 3, pp-1102-1118, 2011.
[32] S. Bresclani, NCO Tomkinson, "Transition Metal Mediated Synthesis of Oxazoles," West Chem., pp-1-2, 2015.
[33] G. W. V. Cave, C. L. Raston, J. L. Scott, Chem. Commun., "Recent advances in solventless organic reactions: towards benign synthesis with remarkable versatility," Chem. Commun., vol. 21, pp-2159-2169, 2001.
[34] G. Nagendrappa, "Organic synthesis using clay and clay-supported catalysts," Appl. Clay Sci. Vol. 53 pp- 106-138, 2011.
[35] P. Prasanna, K. Balamurugan, S. Perumal, J.C. Menendez, "A facile, three-component domino protocol for the microwave assisted synthesis of functionalized naphtho[2,3-b]furan-4,9-diones in water," Green Chem., vol. 13, pp-2123-2129, 2011.
[36] C.R. Strauss, R.S. Varma, "Microwaves in green and sustainable chemistry," Top. Curr. Chem., pp-199-231, 2006.
[37] I. Yavari, H. Djahaniani, "Synthesis of 4H-[1, 3]dithiolo[4, 5-b]pyrroles through the reaction of benzoyl isothiocyanate and dialkyl acetylenedicarboxylates in the presence of Ph_3P," Tetrahedron Lett. vol. 47, pp- 2953-2956, 2006.
[38] I. Yavari, L. Moradi, "A synthesis of isoxazoles through the reaction of activated acetylenes and alkyl 2-nitroethanoates in the presence of triphenylphosphine," Tetrahedron Lett., vol. 47, pp-1627-1629, 2006.
[39] I. Yavari, L. Moradi, "One-pot synthesis of pentaalkyl 7-[(alkylamino)carbonyl]-2-oxa-1-azabicyclo[3.2.0]hept-3-ene- 3,4,5,6,7-pentacarboxylate," Helv. Chim. Acta. vol. 89(11), pp-1942-1946, 2006.
[40] I. Yavari, M. Sabbaghan, Z. Hossaini, "Reaction of hexachloroacetone with activated acetylenes in the presence of N- heterocycles. Synthesis of trichloromethylated bridgehead N-heterocycles," Synlett. vol. 15, pp-2501-2503, 2006.

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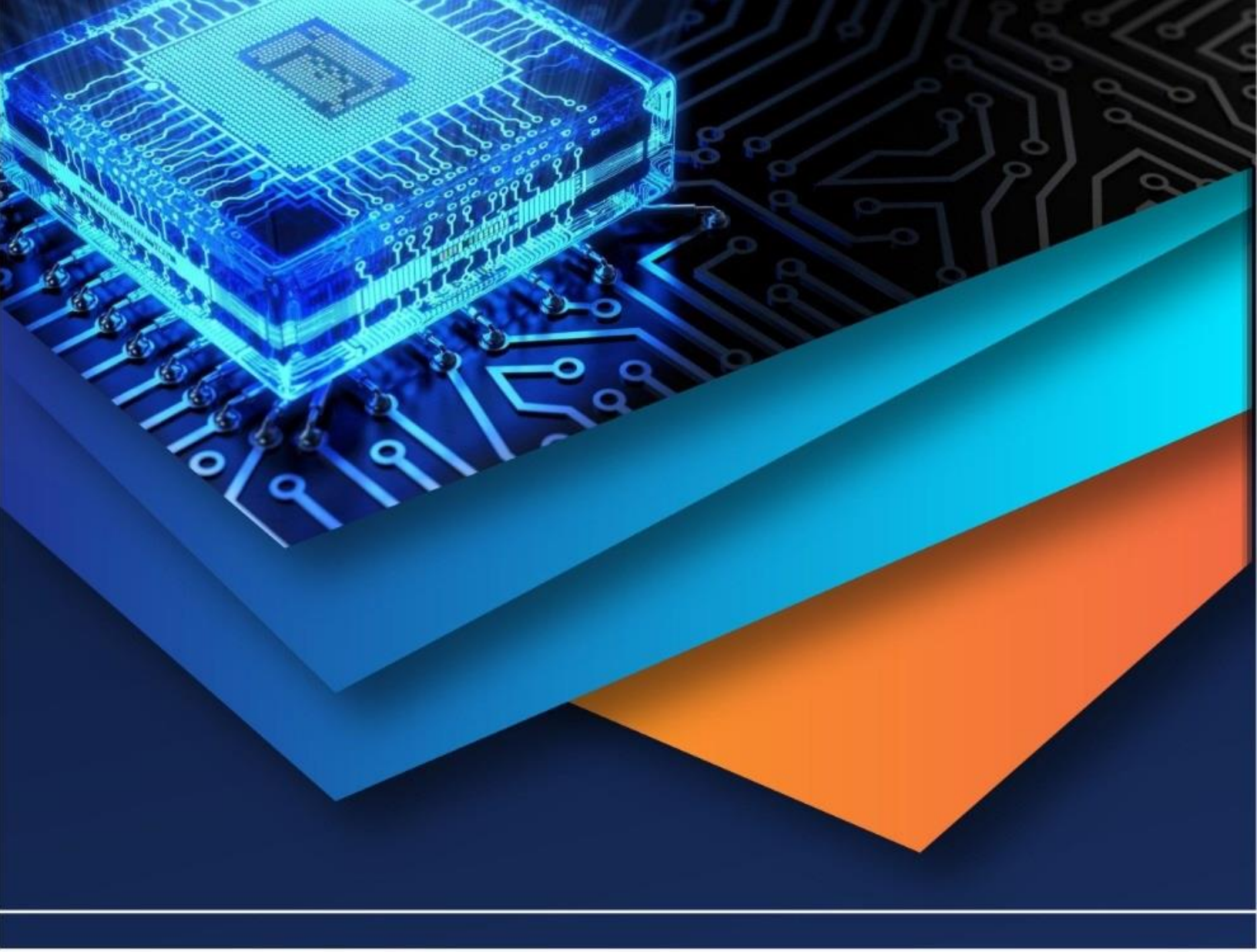

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