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Microwave and Ultrasound-Mediated Synthesis of Pyrazole Derivatives

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Abstract

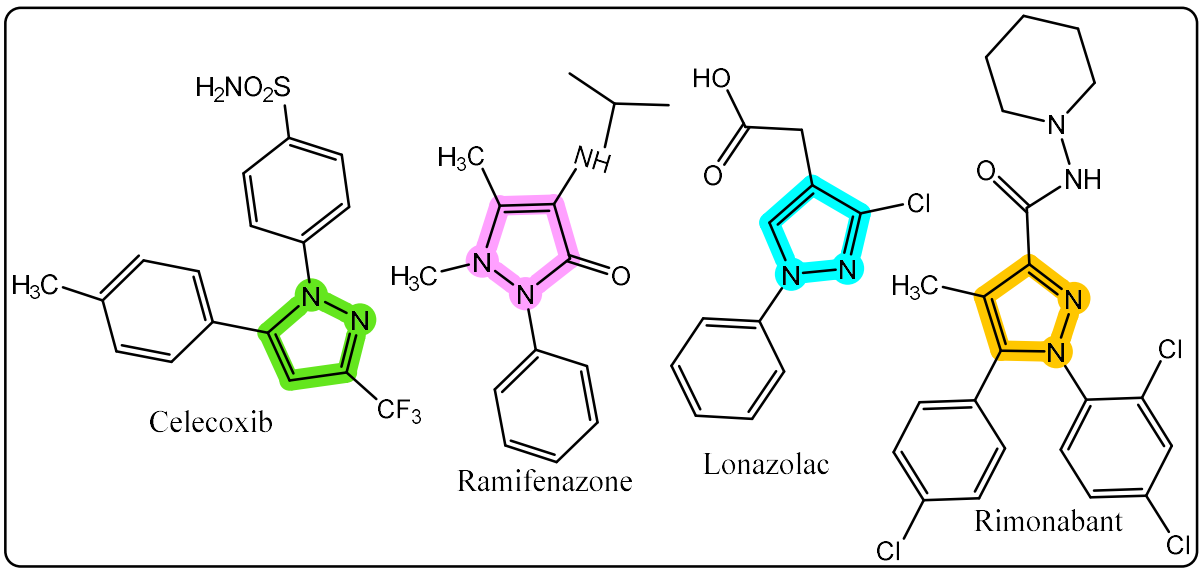
Use of nitrogen-containing heterocycles are frequently present in naturally occurring bioactive compounds they are of considerable study interest. However, there are a number of disadvantages to using typical synthetic methods for these compounds, such as low product yields, severe reaction conditions (such as high temperatures or strong acids), and slow reaction rates. Unconventional synthetic techniques like Sono chemical synthesis and microwave irradiation have become effective and sustainable substitutes in recent years. In synthetic chemistry, these methods offer several advantages, including improved reaction selectivities, increased product yields, and quicker reactions. Additionally, they lessen the need for hazardous solvents. and the total amount of energy needed, which eventually results in more sustainable operations. Additionally, the synthesis of N-heterocycles has improved their environmental compatibility by utilizing green chemistry concepts. The current developments in non-traditional synthetic approaches for creating N-heterocyclic molecules are the main topic of this review. Pyrazoles and their fused analogs are important scaffolds that are discussed. These alternative methods are renowned for their environmental friendliness and synthetic efficiency. likewise given their antibacterial, anticancer, and antioxidant activities, the resultant heterocycles show great promise as physiologically active compounds. The non-conventional synthetic techniques for producing several physiologically active nitrogen-containing heterocycles have been highlighted in this review as quick, effective, and eco-friendly substitutes for conventional methods.

***Key word**: Micro wave, biological, activities, heterocycle.*

Introduction

In organic synthesis, heterocycles particularly those with nitrogen atoms are essential targets. In fact, because these ring structures are found in many physiologically active substances, they have attracted a lot of interest.[1] One N-heterocyclic molecules are still essential in many pharmaceutical domains, according to a brief examination of the most powerful pharmacophores.[2] They specifically serve as scaffolding for compounds with

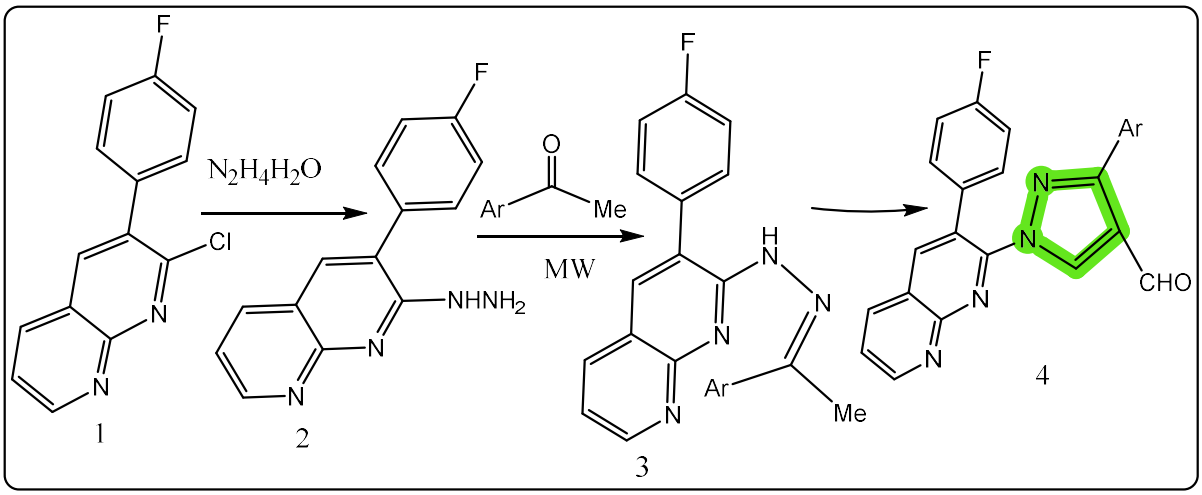
important biological characteristics, medications with antifungal, antibacterial, and anticancer effects. Celecoxib, ramifenazone, lonazolac, rimonabant are notable examples.



Pyrazole drugs

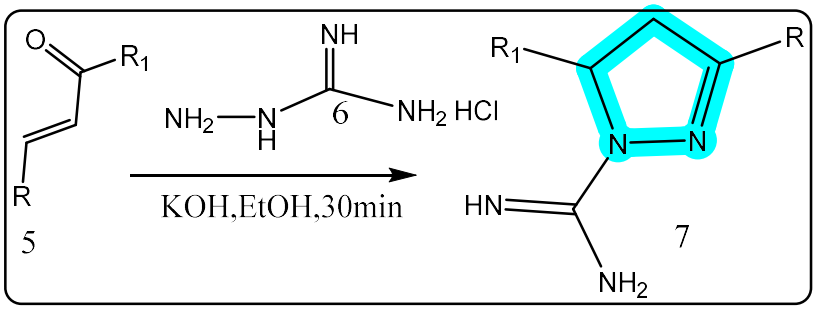
Material and method

Mogilaiah et al. prepared 3-aryl-4-formyl-1-[3-(4-fluorophenyl)-1,8-naphthyridin-2-yl]-pyrazoles 4 using acetophenone, 3-(4-fluorophenyl)-1,8-naphthyridin-2ylhydrazone 3 with POCl3-DMF over silica gel under microwave irradiation [3]



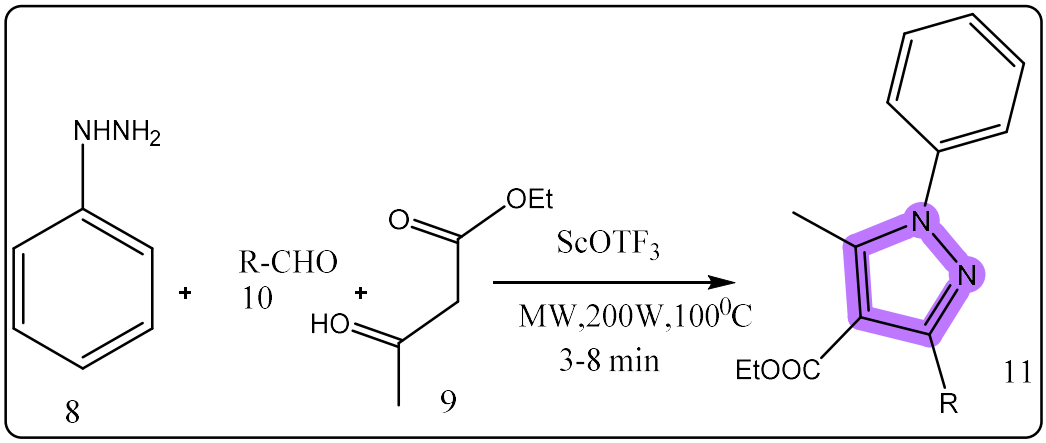
(Scheme1).

In another study, Albuquerque and coworkers repeated this synthetic protocol with different substituted chalcones .Pizzuti and research associates prepared a series of novel 3,5-diaryl-4,5-dihydro-1H pyrazole-1-carboximidamides 7 (R2¼Ph) through a convenient and high-yielding route using chalcones 5 and aminoguanidine hydrochloride 6 under ultrasonic irradiation.[4]



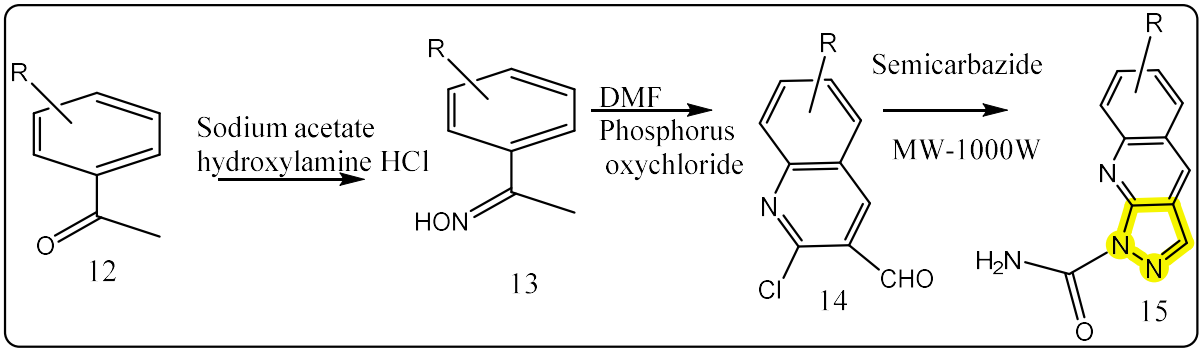
(Scheme 2)

Kumari and co-workers demonstrated a novel application of scandium triflate for the synthesis of functionalized pyrazoles 11 in solvent free conditions through the reaction of phenylhydrazine 8, aldehydes 10 and ethyl acetoacetate 9 .[5]



(Scheme 3)

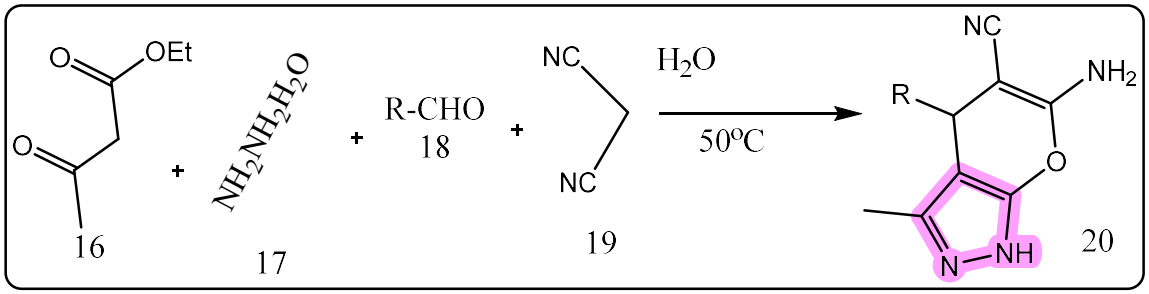
In another study, Alam and colleagues prepared a series of pyrazolo[3,4-b]quinolines 15 by microwave mediated condensation of 2-chloroquinoline-3-carbaldehydes 14 with semicarbazide or 2,4-dinitrophenylhydrazine using water as the solvent in very high yields .[6]



(Scheme 4)

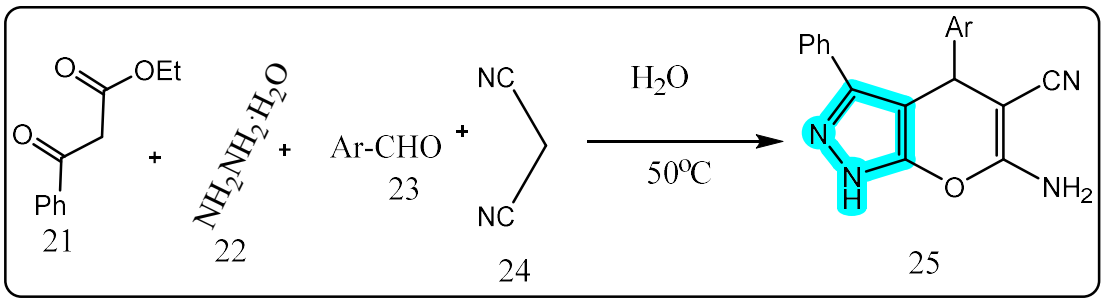
Zou and co-workers documented a convenient and green method for the synthesis of dihydropyrano[2,3-c]pyrazoles 20 by the four-component reaction of aromatic aldehydes

18, hydrazine 17, ethyl acetoacetate 16 and malononitrile 19 in water under ultra sound irradiation .[7]



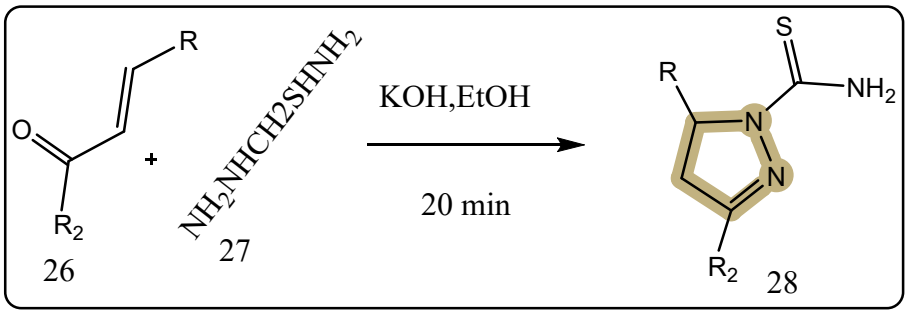
(Scheme 5).

In 2013 an eco-friendly approach toward the synthesis of 6-amino-3-phenyl-4-aryl 1,4-dihydropyrano[2,3-c]pyrazole-5-carbonitriles 25 was reported by Zou et al. via the four-component reaction of hydrazine hydrate 22, ethyl 3-oxo-3-phenylpropanoate 21, aldehydes 23, and malononitrile 24 in water under microwave irradiation.[8]



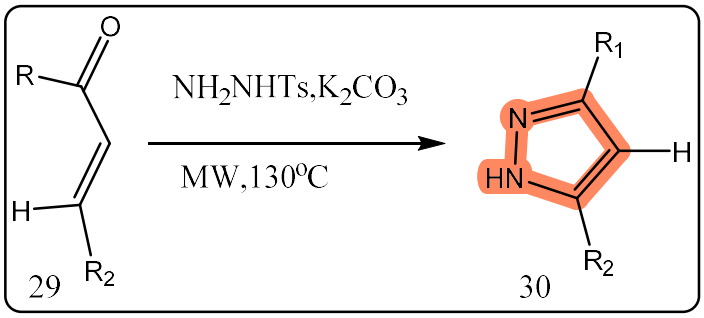
(Scheme 6)

The preparation of thiocarbamoyl-3,5-diaryl-4,5-dihydro-1H-pyrazoles 28 was reported by the Pizzuti research group via the condensation of chalcone 26 with thiosemicarbazide 27 in ethanol and KOH under ultrasonic irradiation [9]



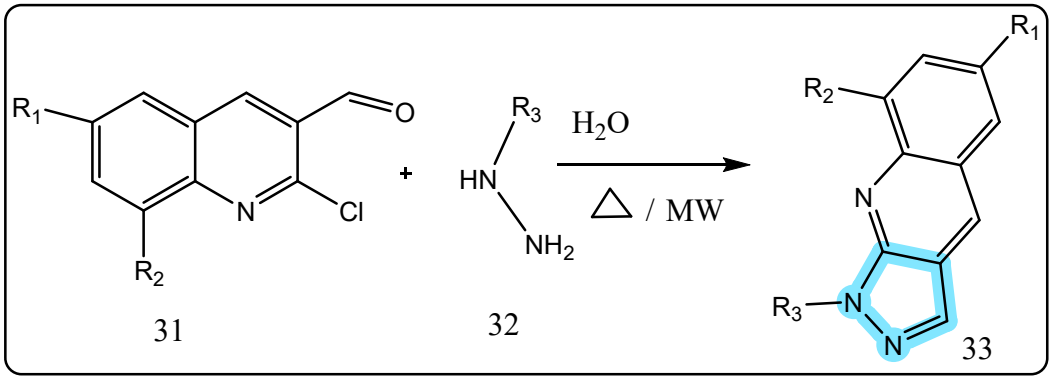
(Scheme 7).

The Cheng group reported the formation of novel 3,5-disubstitued-1H-pyrazoles 30 by cycloaddition of tosylhydrazones and a,b-unsaturated carbonyl compounds containing a b-hydrogen 29 under microwave irradiation in solvent-free reaction conditions[10]



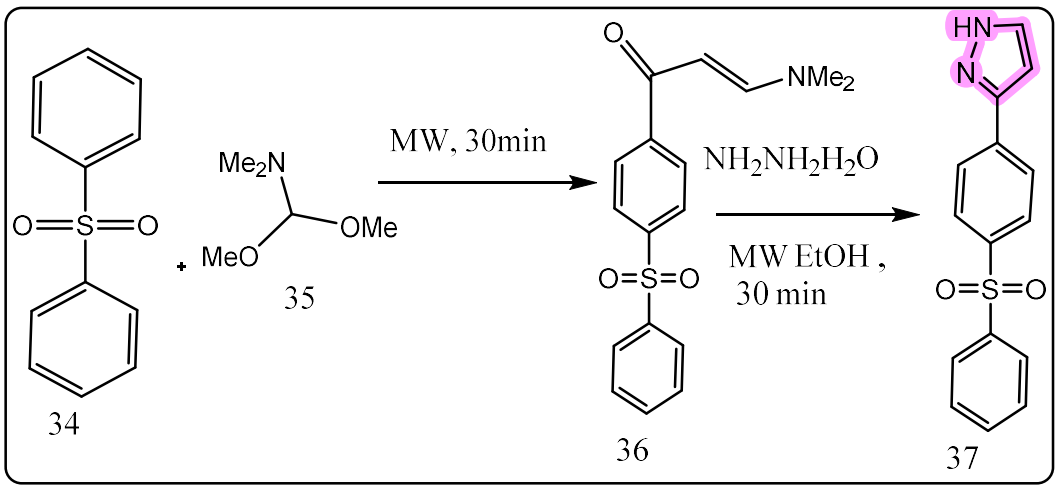
(Scheme 8).

Mali et al. described an efficient route for the synthesis of pyrazolo [3,4- b]quinolones 33 which involved condensation of 2-chloro-3-formyl quinolines 31 and hydrazines 32 (or phenylhydrazine) using microwave (or thermal) energy in water. [11]



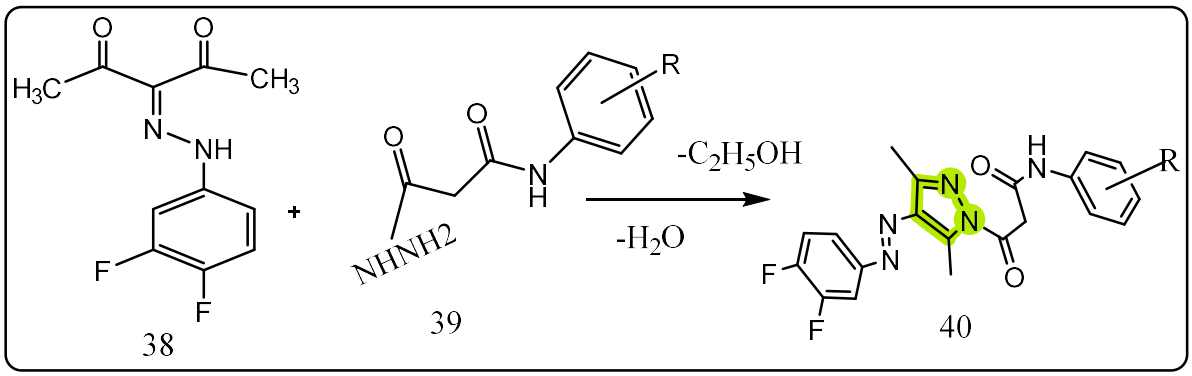
(Scheme 9)

El-Kateb and colleagues reported a facile route for the preparation of pyrazoles 37, pyrimidines, and pyrazolo[1,5-a]pyrimidines from 34 via 36 under microwave irradiation Compound 36 when reacted with 2-aminopyrazole derivatives gave pyrazolo[1,5-a]pyrimidine derivatives under microwave conditions in 89.93% yield. [12]



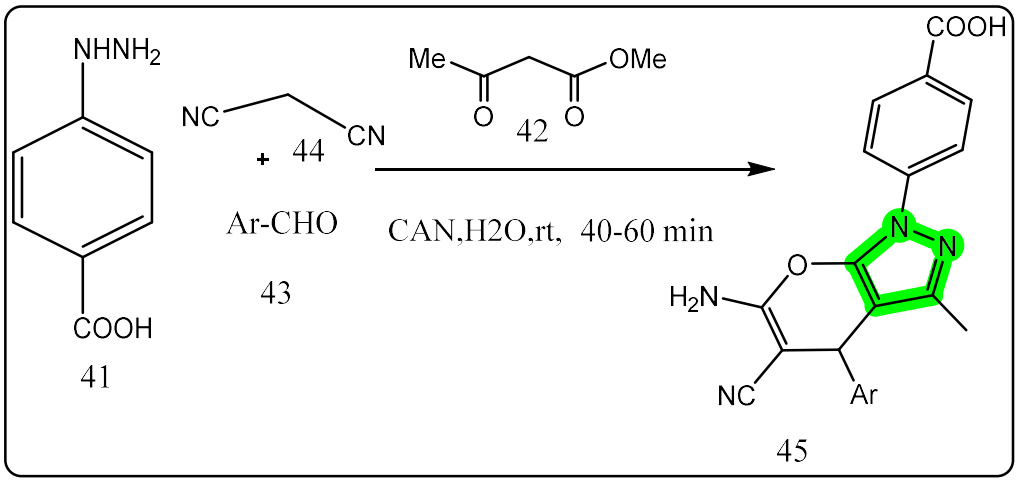
(Scheme 10)

The condensation of 2,4-diketo-3-(3,4-difluorophenylazo)pentane 38 with a number of N-(substituted)phenyl malonamic acid hydrazides 39 yielded 1-(N-substituted aniline malonyl)-3,5-dimethyl-4-(3,4-difluorophenylazo)pyrazoles 40 under microwave irradiation. [13]



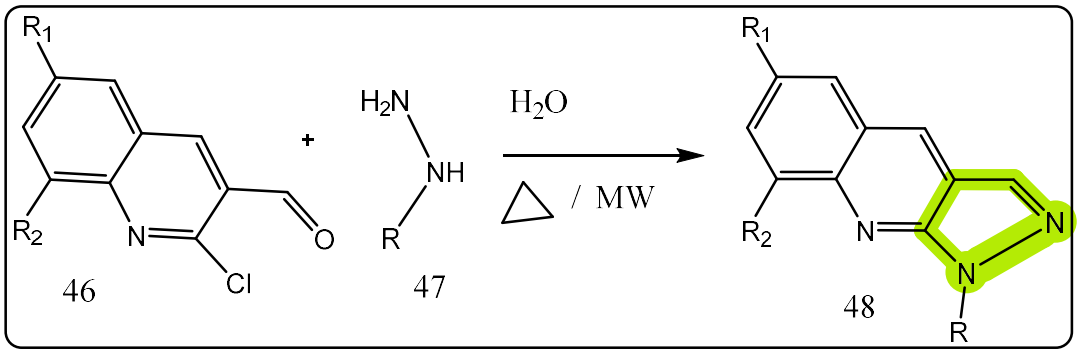
(Scheme 11)

An elegant approach towards the synthesis of functionalized multisubstituted dihydropyrano[2,3-c]pyrazole derivatives 45 using cerium ammonium nitrate (CAN) in water under microwave irradiation was reported by Ablajan and fellow researchers in 2013. This provided an excellent yield of the target pyrazoles by the four-component reaction of 4-hydrazinobenzoic acid 41, b-keto esters 42 aromatic aldehydes 43, and malononitrile 44 using CAN in water under microwave irradiation. [14]



(Scheme 12).

Peng and associates reported the synthesis of 4H-pyrano[2,3-c]pyrazoles 48 in aqueous media using 5-ethoxycarbonyl-2-amino-4-phenyl-3-cyano-6-methyl-4H-pyran 46 and hydrazine hydrate and piperazine in a catalytic amount under combined microwave and ultrasound irradiation [15]



(Scheme 13).

Conclusion.

This review has focused on recent micro wave ultra sound mediated green chemistry developments, It is a resource for chemists seeking a greener synthetic approach to the preparation of pyrazoles and a mitigation of serious environmental issues. Today green chemistry is becoming the standard outlook in organic synthesis, with exciting new developments can be anticipated.

References

1. G. Meera, K. R. Rohit, S. Saranya, G. Anilkumar RSC Adv., 10 (2020), pp. 36031-36041
2. R. Tandon, I. Singh, V. Luxami, N. Tandon, K. Paul Chem. Rec., 19 (2019), pp. 362-393
3. K. Mogilaiah, A. Vinay Chandra, N. Srivani and D. Praveena, Indian J. Chem.- Sect. B Org.Med. Chem., 52, 698 (2013).
4. L. Pizzuti, P. L. G. Martins, B. A. Ribeiro, F. H. Quina, E. Pinto, A. F. C. Flores, D. Venzke and C. M. P. Pereira, Ultrason. Sonochem., 17, 34 ,2010.
5. K. Kumari, D. S. Raghuvanshi, V. Jouikov and K. N. Singh, Tetrahedron Lett., 53, 1130, 2012.
6. M. M. Alam, A. Marella, M. Akhtar, A. Husain, M. S. Yar, M. Shaquiquzzaman, O. P.
7. Tanwar, R. Saha, S. Khanna and S. Shafi, Acta Pol. Pharm.- Drug Res., 70, 435,2013.
8. Y. Zou, H. Wu, Y. Hu, H. Liu, X. Zhao, H. Ji and D. Shi, Ultrason. Sonochem., 18, 708,2011.
9. Y. Zou, Y. Hu, H. Liu and D. Q. Shi, J. Heterocycl. Chem., 50, 1174,2013.

10. L. Pizzuti, L. A. Piovesan, A. F. C. Flores, F. H. Quina and C. M. P. Pereira, Ultrason. Sonochem., 16, 728,2009.
11. A. Corradi, C. Leonelli, A. Rizzuti, R. Rosa, P. Veronesi, R. Grandi, S. Baldassari and C.Villa, Molecules, 12, 1482,2007.
12. J. R. Mali, U. R. Pratap, D. V. Jawale and R. A. Mane, Tetrahedron Lett., 51, 3980,2010.
13. A. A. El-Kateb, N. M. A. El-Rahman, T. S. Saleh, I. F. Zeid and M. F. Mady, Life Sci. J., 9, 711,2012.
14. M. Shukla, D. S. Seth and H. Kulshreshtha, J. Appl. Chem., 2, 1484,2013.
15. K. Ablajan, W. Liju, Y. Kelimu and F. Jun, Mol. Divers., 17, 693,2013.
16. Y. Peng, G. Song and R. Dou, Green Chem., 8, 573,2006.