Chapter

Pyrazole Scaffold: Strategies toward the Synthesis and Their Applications

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Abstract

Pyrazoles have a wide range of applications in medicinal chemistry, drug discovery, agrochemistry, coordination chemistry, and organometallic chemistry. Their popularity has skyrocketed since the early 1990s. Basically, Pyrazole ($C_3H_3N_2H$) is a simple doubly unsaturated five membered heterocyclic aromatic ring molecule comprising two nitrogen (N) atoms at positions 1- and 2- and three carbon (C) atoms. Pyrazole nucleus is synthesized with various strategies such as multicomponent approach, dipolar cycloadditions, cyclocondensation of hydrazine with carbonyl system, using heterocyclic system and multicomponent approach. A special emphasis is placed on a thorough examination of response processes. Furthermore, the reasons for the increasing popularity of pyrazoles in several fields of science are examined. Pyrazoles have recently been the focus of many techniques, mostly because of how frequently they are used as scaffolds in the synthesis of bioactive chemicals and reactions in various media. The goal of this chapter is to discuss the current developments in synthetic techniques and biological activity related to pyrazole derivatives. The many pharmacological functions of the pyrazole moiety and different synthesis techniques were discussed. This chapter has summarized novel strategies and wide applications of pyrazole scaffold.

Keywords: Pyrazole, scaffold, synthesis, application, green synthesis, microwave

1. Introduction

Ludwig Knorr coined the term "Pyrazole" in 1883. A 5-membered ring structure made up of three carbon atoms and two nitrogen atoms in close proximity defines the family of simple aromatic ring organic compounds known as Pyrazoles. These compounds belong to the heterocyclic series. Although being rarely in nature, they are categorized as alkaloids due to their structure and pharmacological effects on humans. Watermelon seeds yielded the first natural Pyrazole, 1-Pyrazolyl-alanine, in 1959 [1, 2]. Pyrazole refers to both an unsaturated parent chemical and a family of simple aromatic ring organic compounds of the heterocyclic diazole series, which are distinguished by a 5-member ring structure made up of two nitrogen atoms in the

neighboring position and three carbon atoms in the central position (**Figure 1**). Pyrazoles have tautomerism because of the moving C-N double bond inside the heterocycle [3, 4]. Pyrazole's 1H-tautomer is known as 1H-pyrazole [5]. It is a base of a pyrazolium conjugate. It is an acid conjugate of pyrazol-1-ide. It is a tautomer of the 3H and 4H Pyrazoles (**Table 1**).

Two techniques have been used to synthesize substituted Pyrazoles (**Figure 2**):

a. Cyclocondensation of hydrazines with 1,3-dicarbonyl compounds or their synthetic 1,3-dielectrophilic equivalents and

b. Cycloaddition of 1,3-dipoles to dipolarophiles

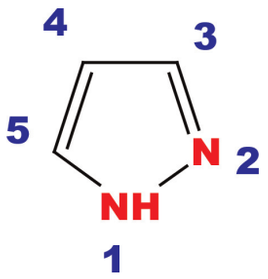

Figure 1.
Structure of Pyrazole.

Molecular Formula	**$C_3H_4N_2$**
IUPAC name	1*H*-pyrazole
Molecular Weight	68.08
Composition	C (52.93%) H (5.92%) N (41.15%)
Boiling Point	187°C
Melting Point	68°C
Hydrogen Bond Donor Count	1
Hydrogen Bond Acceptor Count	1
Rotatable Bond Count	0
Dissociation Constants (pKa)	2.48 (at 25°C)
Molar Refractivity	18.77 ± 0.3 cm^3
Molar Volume	60.9 ± 3.0 cm^3
Parachor	161.0 ± 4.0 cm^3
Index of Refraction	1.528 ± 0.02
Surface Tension	48.6 ± 3.0 dyne/cm
Dielectric Constant	Not available
Polarizability	7.44 ± 0.5 10-24 cm^3
Monoisotopic	68.037448 Da
Nominal Mass	68 Da

Table 1.
Chemistry and properties of Pyrazole [6].

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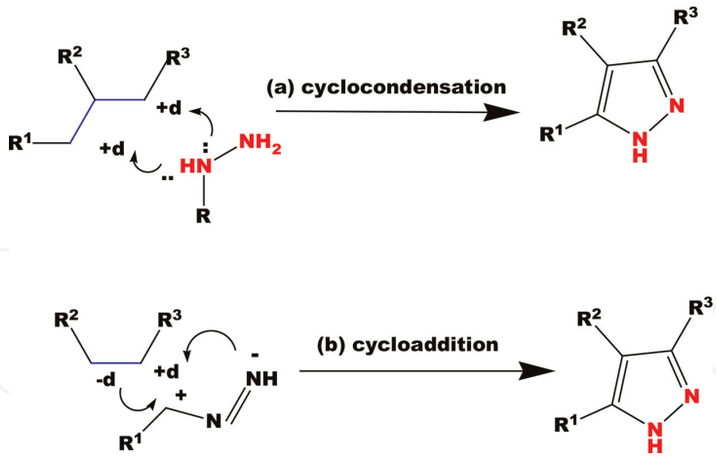

Figure 2.
Traditional methods for synthesizing Pyrazoles are shown in scheme (a) cyclocondensation; cycloaddition (b) [7].

Recently, new methods such multicomponent one-pot procedures, photoredox reactions, and transition-metal catalyzed reactions have been added to these two standard tactics to improve them. In this part, cyclocondensation will be covered first, then cycloaddition [7].

As [NN] synthons, substituted or unsubstituted hydrazines are easily accessible for the production of pyrazole derivatives. When hydrazines react with 1,3-dielectrophilic compounds like 1,3-dicarbonyl or with structures which are carbonyl, such as enones, ynones, and vinyl ketones possessing a leaving group, pyrazole molecules can be produced [8]. Hydrazines and comparable synthetic equivalents can efficiently condense to form substituted pyrazoles from 1,3-diketones, β-ketoesters, 2,4-diketoesters, and related compounds. The 1, 3-diketone and the appropriate hydrazine were cyclocondensed to create a series of powerful carbonic anhydrase, α-glycosidase, and cholinesterase enzyme inhibitors 1 [9]. Wang and co-workers reported a moderate and acid-free condensation of 1,3-diketones with substituted hydrazines to produce the 1,3,5-trisubstituted and completely substituted Pyrazoles [10]. Hydrazines and α-enones can be combined to produce pyrazolines, which can then be oxidized to produce the equivalent Pyrazoles. Iodine was used by Zhang *et al.* to mediate the creation of oxidative intramolecular C-N bonds, and the intermediate hydrazones were then cycled to produce Pyrazoles [11]. Ding *et al.* also described an air-promoted photoredox cyclization of substituted hydrazines with activated alkene (Michael addition reaction acceptors) to produce the corresponding Pyrazoles with good to outstanding yields [12]. Harigae *et al*. reported synthesizing 3,5-disubstituted pyrazoles in one pot with good yields using a regioselective method [13]. 3,5-disubstituted 1H-pyrazoles were also produced using propargylic alcohols, the reduced form of ynones [14]. According to Guo *et al.*, β-amino vinyl ketone may cyclize with tosyl hydrazine in water to produce completely substituted pyrazoles when iodine and tert-butyl hydroperoxide (TBHP) were introduced [15].

1,3-dipolar cycloaddition plays a significant role in creating substituted Pyrazoles due to its inherent high regioselectivity and efficiency [16]. As a departing group, bromine works well. In order to create 3,5-diaryl-4-bromopyrazoles, Sha *et al*. used gemdibromoalkene as the substrate and devised a straightforward, highly effective, and regioselective approach [17]. Li and colleagues described a cycloaddition of dicarboxylic alkynes and hydrazines that was catalyzed by rhodium [18]. Kobayashi et al.

proposed a one-pot, multicomponent method for creating multisubstituted Pyrazoles starting with primary alcohols [19]. In order to assemble monosubstituted Pyrazoles, Yi et al. reported a brand-new silver-mediated [3 + 2] cycloaddition of alkynes and N-isocyanoiminotriphenylphosphorane (NIITP) [20]. Aldehyde hydrazones and maleimides were combined in a moderate reaction by Zhu et al. that used CuCl as a catalyst to produce dihydropyrazoles [21].

All of the [NN] pieces in each of the pyrazole synthesis methods discussed above were derived from azo compounds or hydrazine derivatives. Recent research by Pearce and colleagues describes an unique fragment combination mode [NC] + [CC] + [N] that produces multi-substituted Pyrazoles [22].

The numerous pharmaceutical uses of Pyrazoles have sped up the methodological advancement of pyrazole synthesis. Many general and practical methods, such as the use of transition-metal catalysts, photoredox reactions, one-pot multicomponent processes, new reactants, and novel reaction types, have resulted in fruitful advancements in the fields of the synthesis and functionalization of pyrazole derivatives over the past ten years [7]. A number of noteworthy biological properties of this molecule include those that are antibacterial, anti-inflammatory, anti-cancer, analgesic, anti-convulsant, anthelmintic, antioxidant, and herbicidal. Considering that Pyrazoles are heterocyclic planar five-membered rings, the research suggests that they have a variety of pharmacological effects [4].

1.1 Strategies for pyrazole synthesis

Pyrazoles are the five-membered heterocycles that constitutes several derivatives or compounds which are useful in various fields like drugs, dyes and in organic synthesis. In this section we represents description and discussion on most of the synthetic methods or strategies of pyrazole heterocyclic system.

There are various routes for pyrazole nucleus synthesis which is described as below:

1. Multicomponent approach
2. Dipolar cycloadditions
3. Cyclocondensation of hydrazine with carbonyl system
4. Heterocyclic system

1.2 Multicomponent approach

The multicomponent approach is used for synthesis of pyrazole nucleus by performing one pot synthesis reaction to get high yield of product.

1.2.1 In situ *formation of carbonyl derivatives*

The 3,5-substituted pyrazole derivatives 4 can be synthesized in good yield by the treatment of terminal alkynes 1 with aromatic aldehyde, molecular iodine and hydrazines. It is a very simple and practical method for the preparation of 3,5-substituted pyrazole [13].

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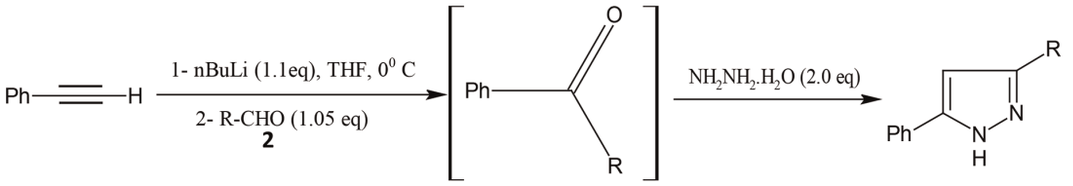
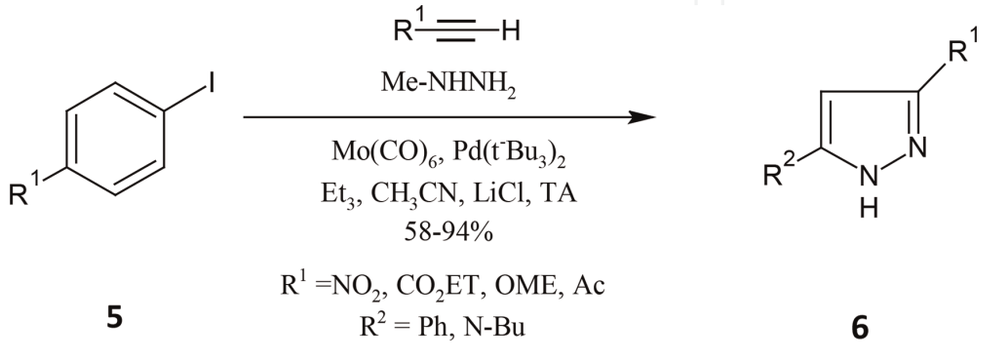
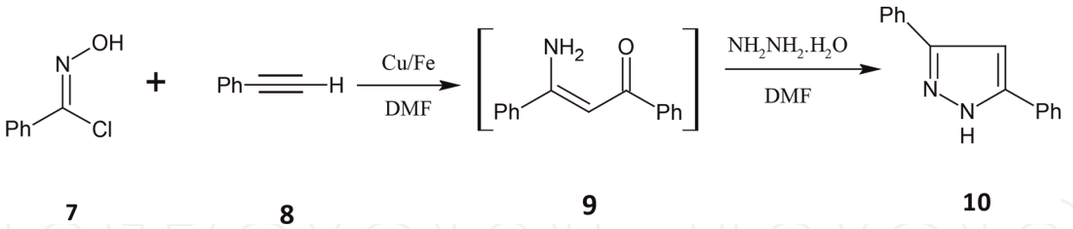


The 1,3,5-substituted pyrazoles 6 was prepared by palladocatalyzed carbonylation of acetylenic acids on aryl iodides 5 in the presence of hexacarbonyl molybdenum with excellent yield [23].



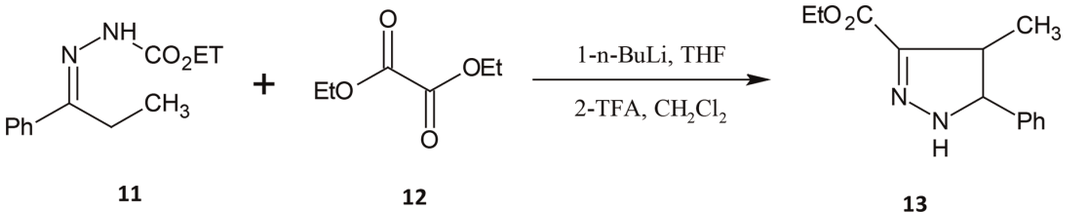
1.2.2 In situ *formation of β-Aminoenones*

The β-Aminoenones synthesized by via coupling between alkyne 8 and an oxime 7 in dimethylformamide which was transformed into pyrazoles 10 with the addition of hydrazine in one pot procedure in good yield [24].

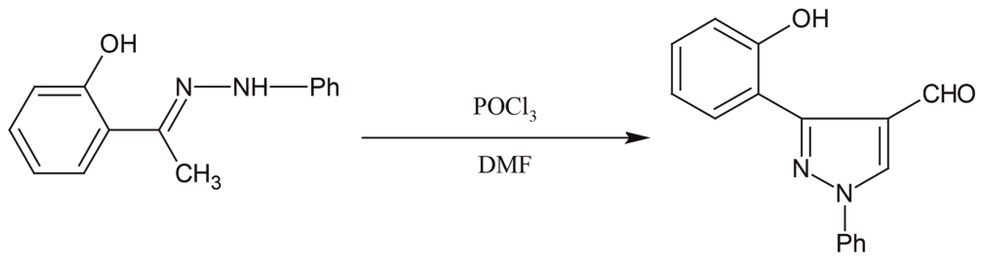


1.2.3 In situ *formation of a Hydrazone*

It is a novel reaction in which the cyclization of diethyl oxalate 12 with the dianions of hydrazones 11 afforded the pyrazole-3-carboxylates 13 in good yields [25].



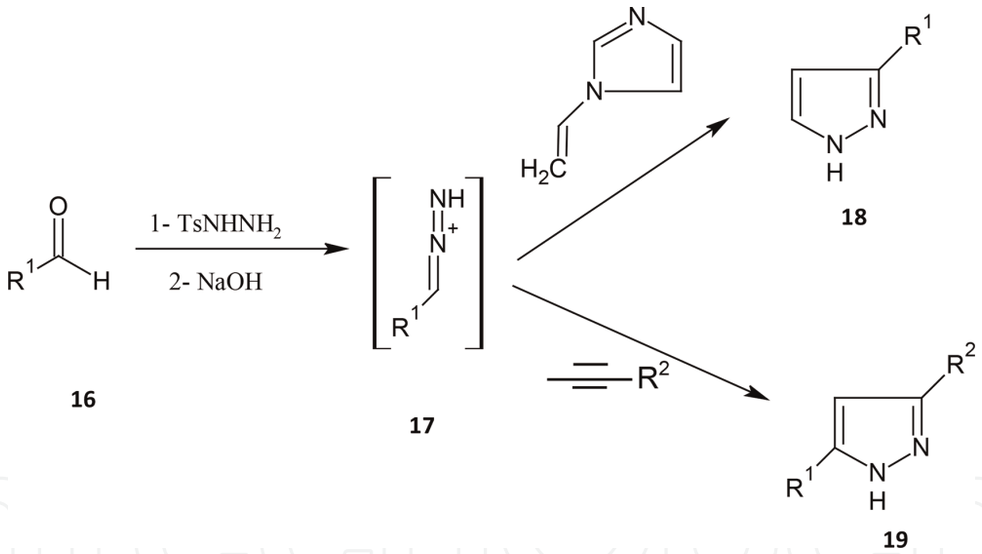
The condensation of hydrazine in the presence of phosphorus oxychloride gives the 4-formyl pyrazole 15 which is called as Vilsmeier-Haack reaction [26].



14 15

1.2.4 In situ *formation of diazo compounds*

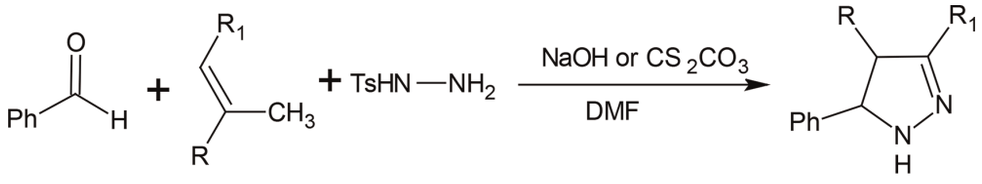
The Aggarwal team has developed a multicomponent process in which diazo 17 derivatives are generated in situ from various aldehydes 16 and tosylhydrazines, thus limiting the risks associated with the isolation of these compounds. These are then used in a 1,3-dipolar cycloaddition reaction to give corresponding pyrazoles 18 and 19 Diazo compounds derived from aldehydes were reacted with terminal alkynes to furnish regioselectively 3,5-disubstituted pyrazoles in 24–67% yields [27].



16 17 18 19

1.2.5 Ring opening reaction

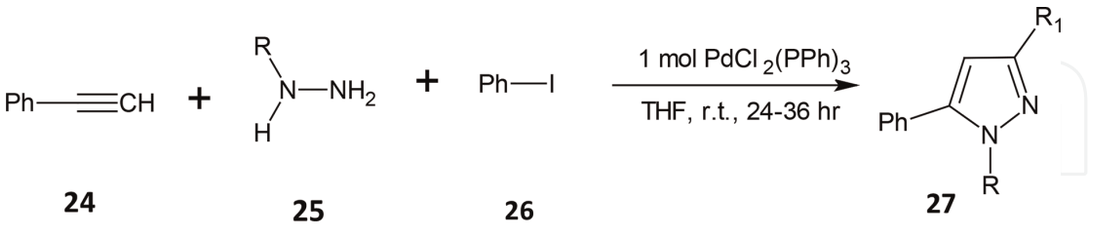
A palladium-catalyzed ring opening reaction of 2H-azirines with hydrazones provides polysubstituted pyrazoles 23 with a wide substrate scope [28].



20 21 22 23

1.2.6 Multicomponent reaction

Pyrazole or isoxazole derivatives 27 are prepared by a palladium-catalyzed four-component coupling of a terminal alkyne 24, hydrazine 25 (hydroxylamine), carbon monoxide under ambient pressure, and an aryl iodide 26 [29].



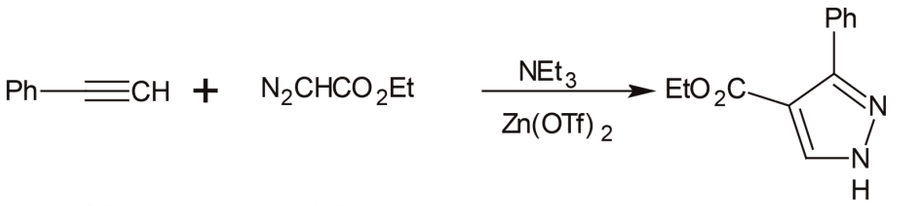
24 **25** **26** **27**

1.3 Dipolar cycloadditions

In this method the pyrazole nucleus was synthesized by the cycloaddition between an alkyne and 1,3-dipolar compounds such as diazo compounds.

1.3.1 Cycloaddition of Diazocarbonyl compounds

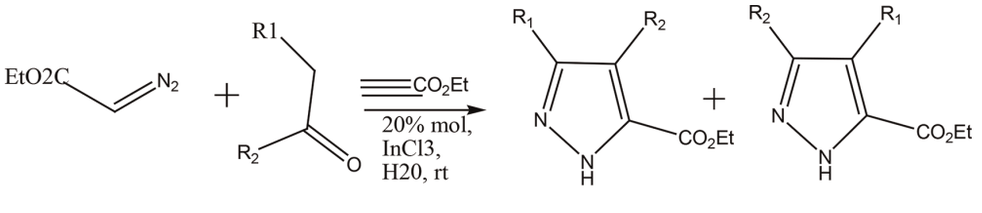
The action of ethyl diazoacetate 29 on phenylpropargyl 28 in triethylamine and in the presence of zinc triflate as a catalyst; the 1,3-dipolar cycloaddition reaction, leads to the corresponding pyrazole 30 in good yield (89%) [30].



28 **29** **30**

1.3.2 Cycloaddition of ethyl diazoacetate

A facile one-pot procedure for the synthesis of pyrazole-5-carboxylates 31 by 1,3-dipolar cycloaddition of ethyl diazoacetate 32 with methylene carbonyl compounds utilizing 1,8-diazabicyclo[5.4.0]undec-7-ene (DBU) as base and acetonitrile as solvent [31].

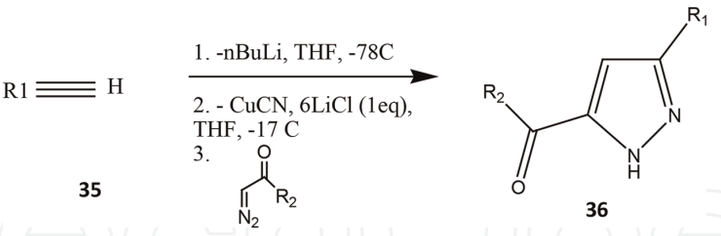


31 **32** **33** **34**

1.3.3 Cycloaddition of acetylides with diazocarbonyl compounds

A direct and efficient access towards 3-acylpyrazoles 36 that involves the copper-promoted cycloaddition of acetylides 35 with diazocarbonyl compounds under mild

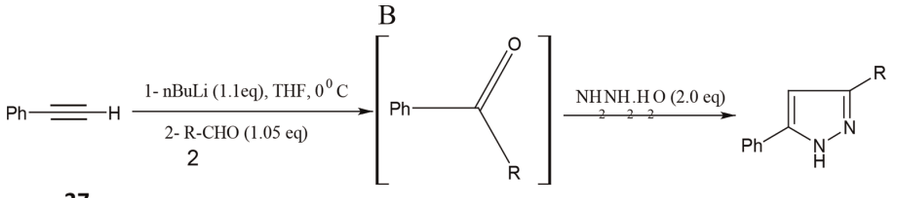
conditions. A wide variety of substituents is tolerated at both the acetylide and the diazo compound [32].



35 **36**

1.3.4 The syndones

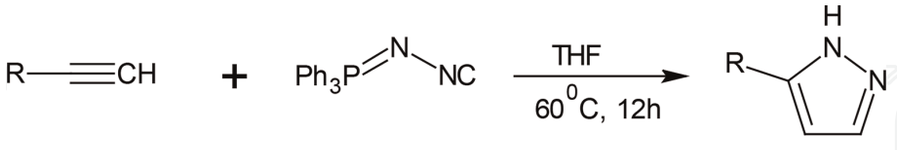
The pyrazoles can be obtained by a cycloaddition reaction of sydnones. The synthesis of a trisubstituted pyrazole 39, by 1,3-dipolar cycloaddition of arylsydnones and unsaturated ketone in dry xylene [33].



37 **38** **39**

1.3.5 Cycloaddition of N*-isocyanoiminotriphenylphosphorane*

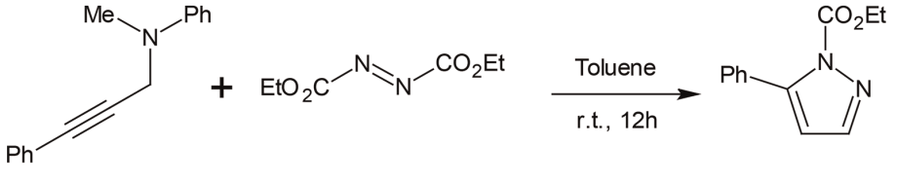
A silver-mediated [3 + 2] cycloaddition of *N*-isocyanoiminotriphenylphosphorane as "CNN" building block to terminal alkynes provides pyrazoles 42. *N* isocyanoiminotriphenylphosphorane is a stable, safe, easy-to-handle, and odorless solid isocyanide 41. The reaction offers mild conditions, broad substrate scope, and excellent functional group tolerance [20].



40 **41** **42**

1.3.6 Cycloaddition reaction of dialkyl azodicarboxylates

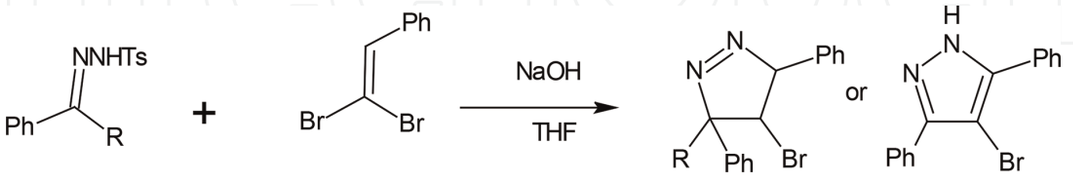
A phosphine-free [3 + 2] cycloaddition reaction of dialkyl azodicarboxylates 44 with substituted propargylamines 43 provides functionalized pyrazoles 45 in good yields and high selectivity at room temperature [34].



43 **44** **45**

1.3.7 Cycloaddition of diazo compounds and alkynyl bromides

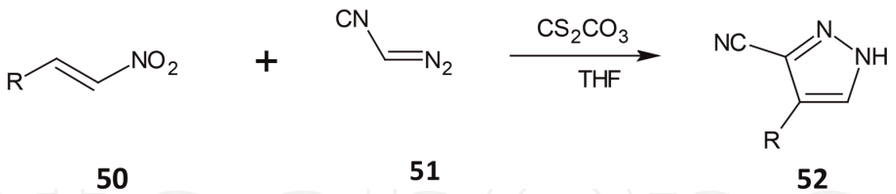
A simple, highly efficient, 1,3-dipolar cycloaddition of diazo compounds 46 and alkynyl bromides 47 gives 3,5-diaryl-4-bromo-3*H*-pyrazoles 48 or the isomerization products 3,5-diaryl-4-bromo-1*H*-pyrazoles 49 in good yields. The diazo compounds and alkynyl bromides were generated in situ from tosylhydrazones and *gem*-dibromoalkenes, respectively. The reaction system exhibited high regioselectivity and good functional group tolerance [35].



46 **47** **48** **49**

1.3.8 Cycloaddition of diazoacetonitrile and nitroolefins

A transition-metal-free [3 + 2] cycloaddition reaction between diazoacetonitrile 51 and nitroolefins 50 provides multisubstituted cyanopyrazoles 52. This protocol offers mild reaction conditions, broad substrate scope, good yields, and regioselectivities. A one-pot three-component reaction of nitroolefins with diazoacetonitrile and alkyl halides also provides multisubstituted cyanopyrazoles in good to high yields [36].



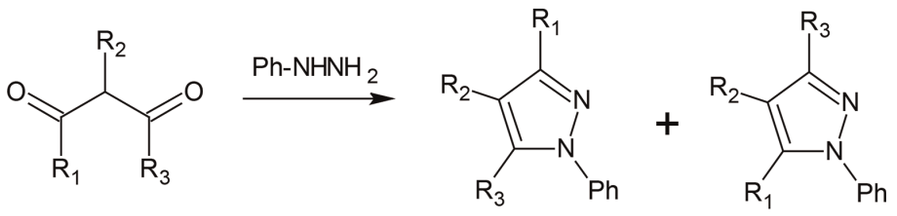
50 **51** **52**

1.3.9 Cyclocondensation of hydrazine with carbonyl system

This is a leading method used for obtaining substituted pyrazoles is a cyclocondensation reaction between an appropriate hydrazine acting as a bidentate nucleophile and a carbon unit like a 1,3-dicarbonyl compound, a 1,3-dicarbonyl derivatives or an unsaturated ketone.

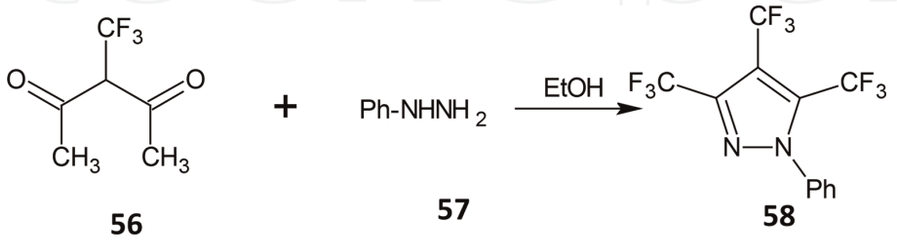
1.3.10 From 1,3-diketones

The cyclocondensation of the 1,3-dicarbonyl compounds 53 with the hydrazine derivatives is a simple and rapid approach to obtain polysubstituted pyrazoles 54 and 55. The first synthesis of the substituted pyrazoles was carried out in 1883 by Knorr et al. [11] who reacted diketone with hydrazine derivatives to give two regioisomers [37].



53 **54** **55**

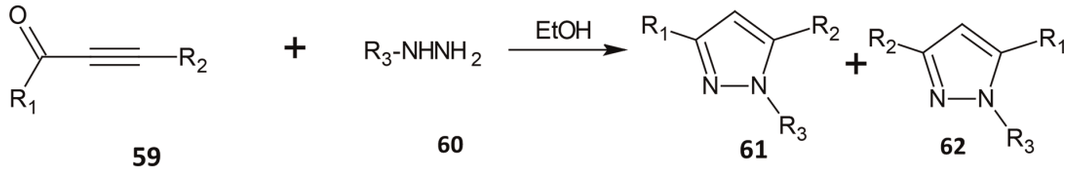
The condensation of phenylhydrazine 57 with the trifluoromethyl)-1,3-diketone 56 in ethanol, affording 1,3,4,5-substituted pyrazole in good yield (63%) [38].



56 **57** **58**

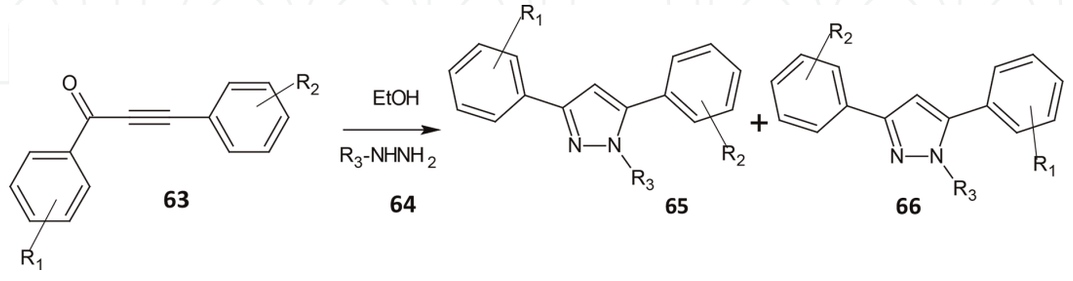
1.3.11 From Acetylenic ketones

The cyclocondensation reaction of hydrazine derivatives 60 on acetylenic ketones 59 to form pyrazoles. The reaction between hydrazine derivatives and acetylenic ketones forms pyrazoles and the reaction again results in a mixture of two regioisomers 61 and 62 [39].



59 **60** **61** **62**

The cyclocondensation of acetylenic ketones 63 on methylhydrazine or aryl hydrazines 64 in ethanol, which provides two difficultly separable regioisomeric pyrazoles 65 and 66 [40].



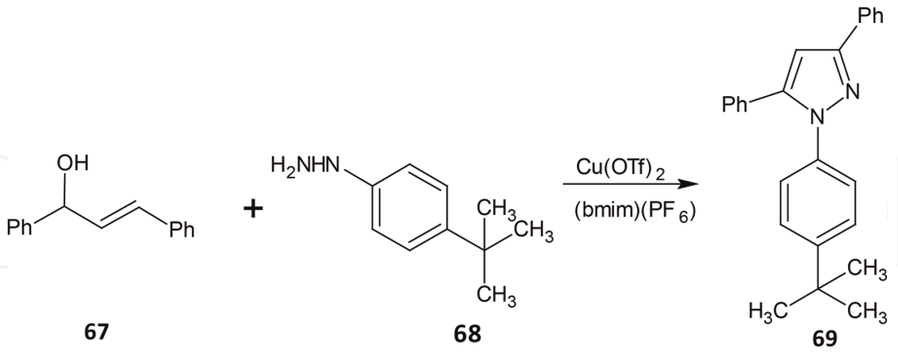
63 **64** **65** **66**

1.3.12 From vinyl ketones

The cyclocondensation reaction between an ethylenic ketone and a hydrazine derivative results in the synthesis of pyrazolines which, after oxidation, provide the pyrazole ring.

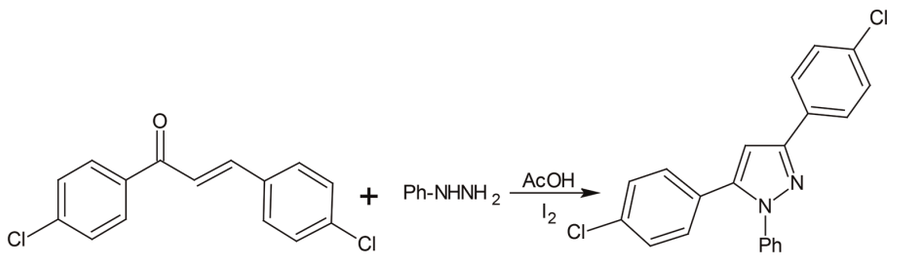
The condensation of an ethylenic ketone 67 with p-(4-(tert-butyl)phenyl) hydrazine 68 in the presence of copper triflate and 1-butyl-3-methylimidazolium

hexafluorophosphate bmim] (PF6) as catalysts, to access pyrazoline 69. The corresponding 1,3,5-trisubstituted pyrazole was obtained after oxidation in situ of this pyrazoline [41].



67 68 69

Cyclocondensation of the ethylenic ketone 70 with phenylhydrazine (1.2 eq.) in acetic acid and in the presence of iodine (1.0 eq.) afforded the corresponding pyrazole 71 in good yield (70%) [42].

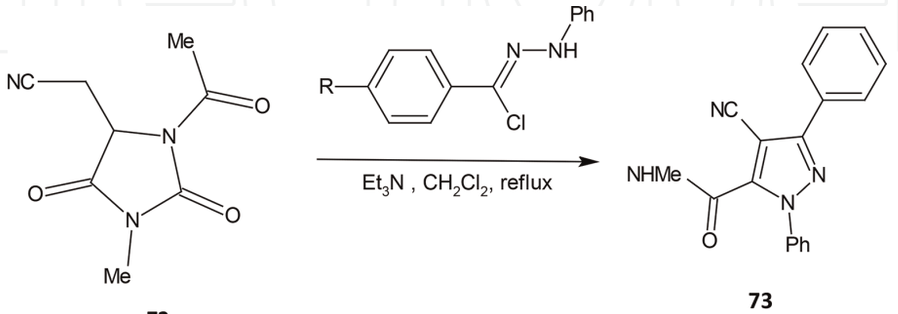


70 71

1.4 From heterocyclic system

1.4.1 From imidazole

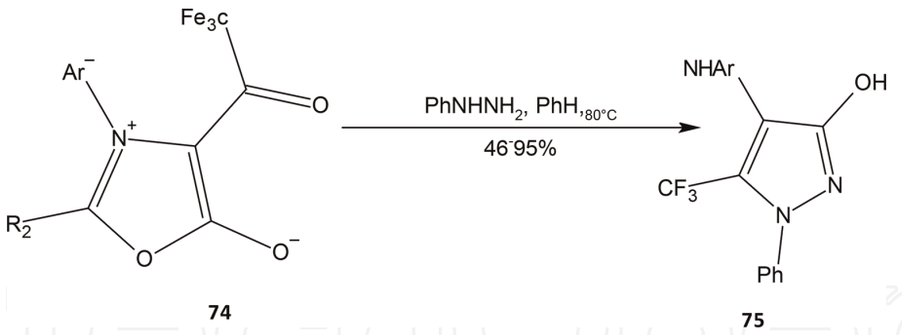
Cycloaddition of (5Z)-1-acyl-5-(cyanomethylidene)-3-methylimidazolidine-2,4-diones 72 with arylhydrazonyl chloride under basic conditions to give pyrazole-5-carboxamides 73 in moderate 27–40% yields [43].



72 73

1.4.2 From oxazole

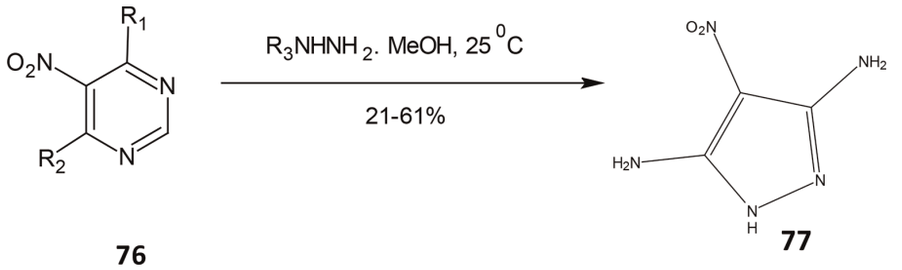
5-Trifluoromethyl-3-hydroxypyrazoles 75 were obtained in good yield (46–95%) by heating phenylhydrazine and 4-trifluoroacetyl-1,3-oxazolium-5-olates 74 under reflux of benzene [44].



74 75

1.4.3 From pyrimidine

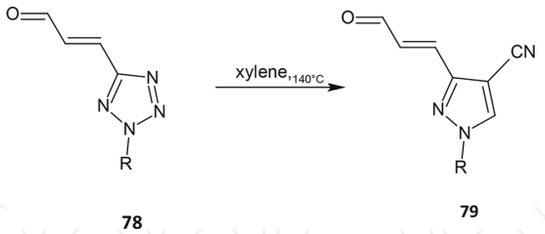
The reaction of nitropyrimidine 76 with arylhydrazines in methanol at room temperature, to afford 4-nitro-3,5-diaminopyrazoles 77 in yields of 21–61% [45].



76 77

1.4.4 From Tetrazole

Tetrazolyl acroleins 78 reacts with fumaronitrile in xylene at 140°C to give the corresponding pyrazole formation 79 [46].



78 79

2. Applications of pyrazole scaffold

Pyrazole moiety have wide applications and are effective therapeutic scaffolds that display a wide range of biological actions as listed in **Figure 3**.

The synthesis of a novel, powerful family of 5-reductase and aromatase inhibitors derived from 1, 2, 3-triazole derivative uses pyrazole-4-carbaldehyde as the starting material. The appropriate Schiff bases were created by condensation of the starting material with active methylene and various amino pyrazoles. In contrast, starting material was treated in a single pot with ethyl cyanoacetate and thiourea to produce pyrazolo-6-thioxopyridin-2-[3H]-one. Additionally, beginning chemical was reacted with p-methoxy acetophenone, which then reacted with each of the ethyl cyanoacetates to create an unsaturated chalcone derivative. The following derivatives showed 5-α reductase inhibitor and aromatase inhibitor activity prominently

Figure 3.
Biological activity of pyrazole moiety.

compared to reference drug. It is due to the pyridine moiety was present and it was connected to the pyrazoline and 1, 2, 3-trizole moieties (**Figure 4**) [47].

Sequence of pyrazolinyl and pyrazolyl pregnenolones were produced and their ability for both series to inhibit 5- α reductase was examined by multiple step synthesis and pregnenolone used as starting material. Cyclization reaction was found to be main step in this synthesis. Derivatives 4b, 4c and 6b were found to be more active for this activity as it contains fluoro group and para position chloro group. 4b and 4c contain Ar ring as follows (**Figures 5** and **6**) [48].

Khalillulha H et al. synthesized pyrazole derivatives covering 1, 4-dioxane ring which have low-molecular-weight molecules that are simple to manufacture. On the other hand, silybin is a complicated, highly molecular substance that is difficult to manufacture. In addition, the substances are anticipated to be easily metabolizable, in contrast to silybin, which is straightforward and has a low molecular

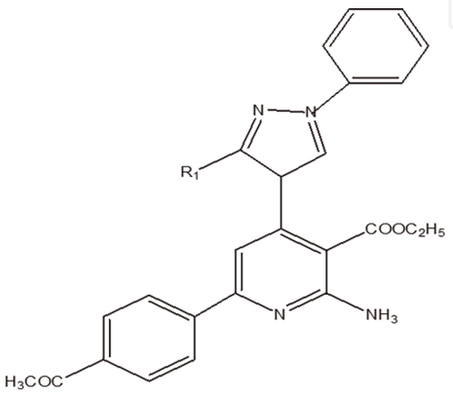


Figure 4.
Potent derivative showing 5- α reductase inhibitor activity.

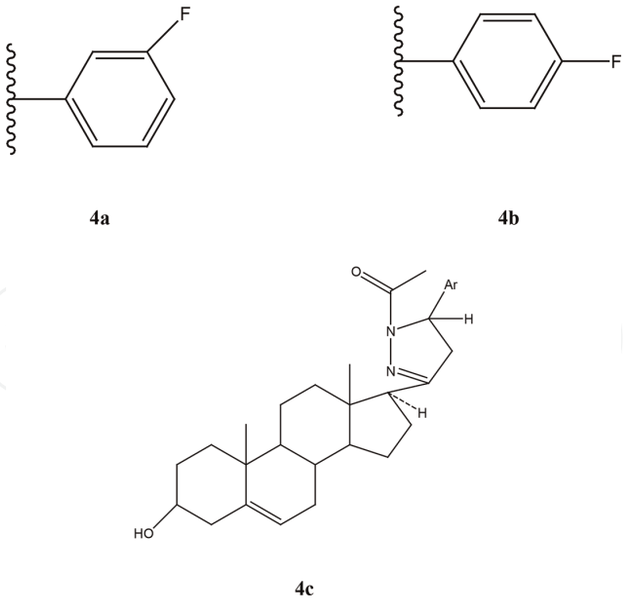


Figure 5.
Potent compound of pyrazolinyl pregnenolone.

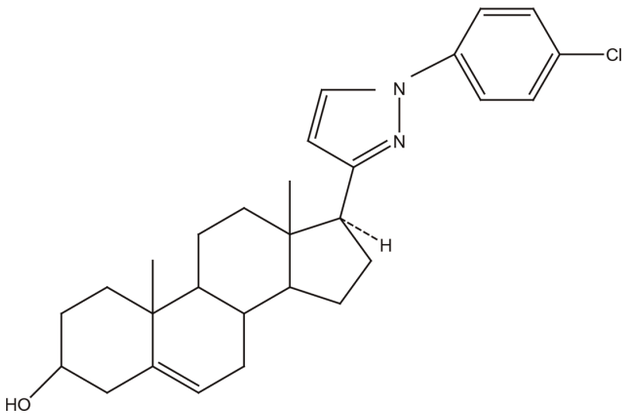


Figure 6.
6b derivatives of pyrazolyl pregnenolone.

weight. These derivatives were prepared by Claisen–Schmidt condensation reaction using substituted acetophenone chalcones. Rats' liver damage caused by CCl_4 was used in a hepatotoxicity investigation (**Figure 7**) [49].

MAO enzyme having EC number 1.4.3.4 that contain flavin Hence inhibitory activity was done by different researchers like Chimenti F et al. synthesized 1-Thiocarbamoyl-3, 5-diaryl-4, 5-dihydro-(1H) - pyrazole Derivatives by using

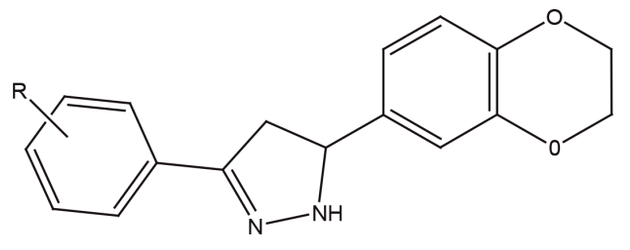


Figure 7.
Pyrazoline derivative.

chalcones, thiosemicarbazide with potassium hydroxide in ethanol as solvent. Its isomers were also tested for MAO inhibitory action. Substrate used was kynuramine. Derivative containing following group those are highly active for MAO inhibition. To check bonding affinity for MAO computational methods were also carried out. Following derivative shows potent activity (**Figure 8**) [50].

Secci D prepared pyrazole derivatives are produced either by intermolecular [3 + 2] cycloadditions of 1, 3-dipoles to alkynes excellent inhibitory effect primarily against MAO-B contain halo group when placed in the para position of the aryl group (**Figure 9**) [51].

Alam MS et al. used schiff base ligand 4-amino-1, 5-dimethyl-2-phenylpyrazole-3-one with benzaldehyde to form single crystal which was checked by X-ray diffraction analysis. For detection of antioxidant activity they used DPPH Radical Scavenging Activity assayed by Blois method (**Figure 10**) [52].

Gressleri, A et al. prepared derivatives by refluxing for 24 hours with the use of 1, 5-diarylpenta-1, 4-dien-3-ones, aminoguanidine hydrochloride, triethylamine, and ethanol. For antioxidant activity DPPH was used and the color of the DPPH shifts from violet to yellow. From all the synthesized derivatives 1-carboxyamidino-1*H*-pyrazole derivatives showed potent activity. [53] Hanam A et al. made an effort to produce new heterocycles, 2-cyano-3-(1,3-diphenyl-1H-pyrazol-4-yl) acryloyl chloride was subjected to reactions with various mono-, 1,2-, 1,3-,1,4-, and 1,5-binucleophiles. Assay was performed by using ABTS [2, 20 -azinobis-(3-

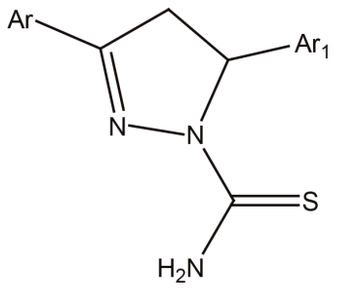


Figure 8.
Pyrazole derivatives.

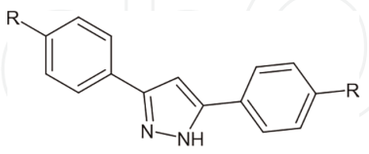


Figure 9.
Cycloaddition derivative.

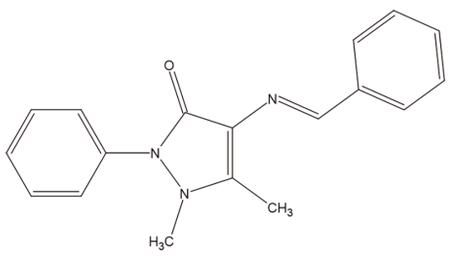


Figure 10.
Pyrazole Schiff base derivative.

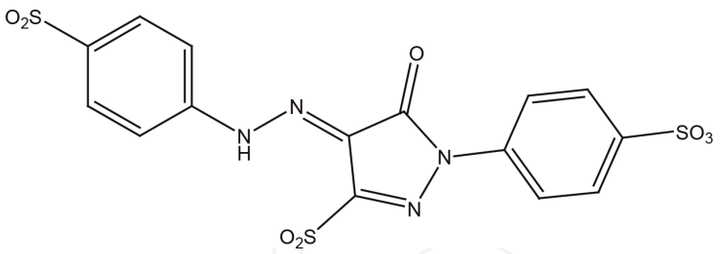


Figure 11.
Structure of tetrazine.

ethylbenzthiazoline-6-sulphonic acid)] method. In that comparison was done by ascorbic acid as standard (**Figure 11**) [54, 55].

Alsayari A, et al. prepared pyrazole derivatives by A sulforhodamine B assay method which was used to assess the antiproliferative effects on cancer cell lines were identified: hepatocellular carcinoma (HepG2), colorectal carcinoma (HCT-116), and breast cancer (MCF-7). These are effective xanthine oxidase inhibitory action (IC50 0.83 M) and a high IC50 against the human colon cancer cell line (**Figure 12**) [56].

Different anticancer activity showing in pyrazole moiety were listed here, the preclinical or early-phase clinical trials for these described drugs were passed (**Figure 13**) [57].

Three different breast cancer cell lines, such as MDA-MB-231, MCF-7, and 4 T1, all were used by authors for breast cancer cell line study as well as HepG2 liver cancer cells, were used to test the cytotoxicity of pyrazole. Synthesized pyrazole 13 derivative (5-oxo-N′-(2-oxoindolin-3-ylidene)-3-phenyl-4,5-dihydro-1H-pyrazole-1-carbothiohydrazide), mechanism was discussed as caused 4 T1 cells to die by preventing wound healing and colony formation, delaying the G0/G1 phase of the cell cycle, activating p27 levels, and most likely inducing apoptosis through DNA intercalation. IC50 value of this synthesized derivative was found to be 25 ± 0.4 μm (**Figure 14**) [58].

Human lung carcinoma A549 cells, murine P388 leukemia cells, and human ovarian adenocarcinoma A2780 cells were all tested with pyrazole derivatives by synthesizing this derivatives 2-pyridinyl moiety containing compound 12 is mostly active as shown below (**Figure 15**) [59].

Cyclin-dependent kinases (CDKs), a subfamily of the protein kinase which control the cell cycle. Given that cyclin E is selective for CDK2 and the dysregulation of particular cancer types, CDK2 is an alluring target for malignancies with particular genotypes. According to the ongoing clinical trials, CDKs inhibitor, specifically CDK2/cyclin A-E, has the potential to be a reliable cancer target. The majority of the pyrazole scaffolds have demonstrated CDK2 inhibitor selectivity and potency [60, 61]. The antibacterial activity of a series of 1H-pyrazole-3-carboxylic acid derivatives against Bacillus cereus, Staphylococcus aureus, Escherichia coli, and Pseudomonas putida were assessed by Akbas et al. Having antibacterial action against both Gram-positive

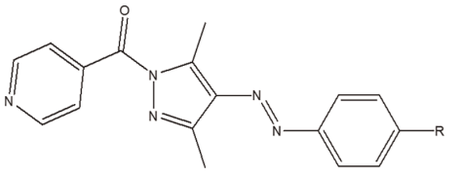


Figure 12.
Pyrazole derivative as anticancer.

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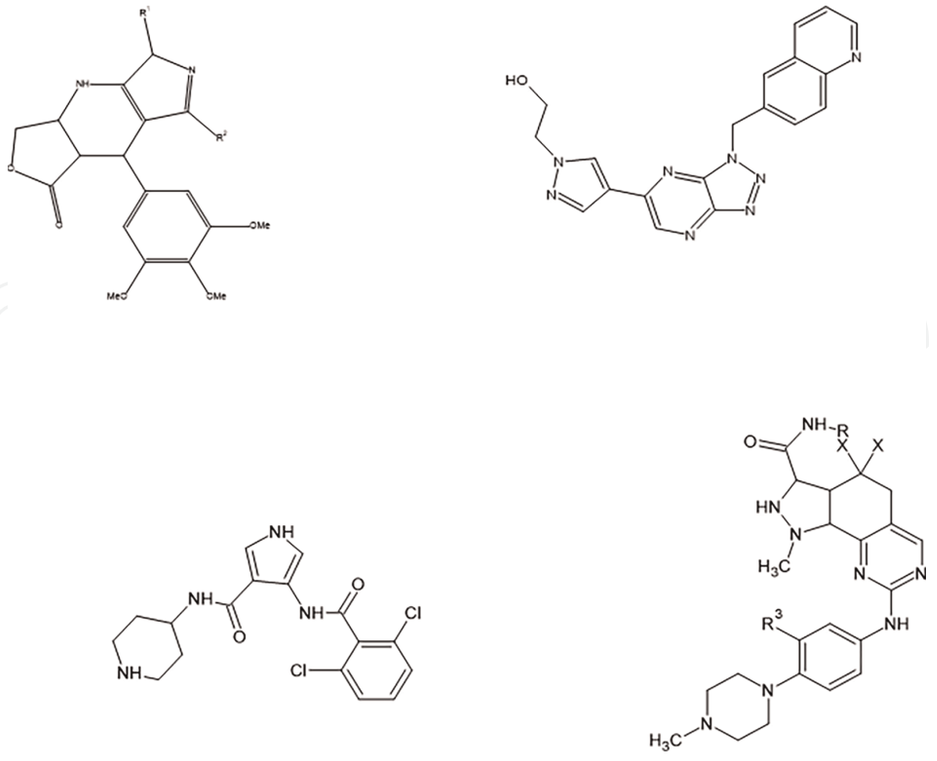

Figure 13.
Pyrazole derivative in preclinical study.

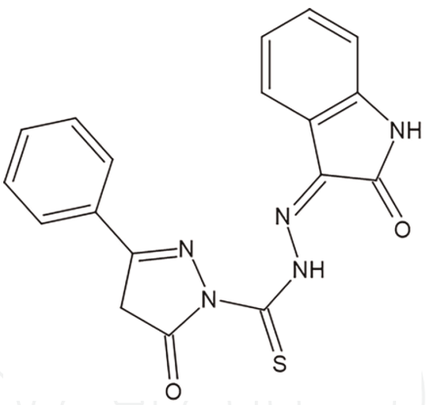

Figure 14.
Pyrazole 13 derivative.

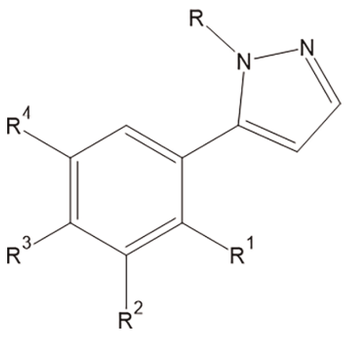

Figure 15.
Pyrazole 12 derivative.

and Gram-negative bacteria, the results revealed that compound 5c was the best compound in the series (**Figure 16**) [62].

For the detection of pyrazole pesticides such as fibronil in water samples of environment, method solid-phase extraction (SPE) approach combining with high-performance liquid chromatography as adsorbent multi-walled carbon nanotubes was developed by Ma Jiping et al. [63] (**Figure 17**).

An essential scaffold is 3-bromo-1-(3-chloropyridin-2-yl)-1H-pyrazole-5-carbohydrazide, which is produced by Wang Y et al. as an insecticidal compounds. By using species *Helicoverpa armigera* and *Plutella xylostella* as standard tebufenozide. Fluoro group containing compound showed potent activity at fourth position and decreased by iodo group [64] (**Figure 18**).

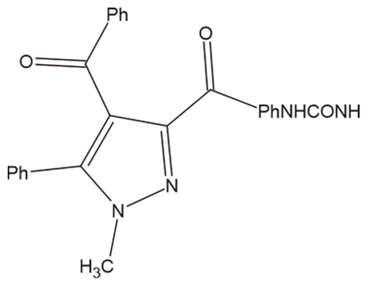

Figure 16.
5C (Pyrazole carboxylate derivative).

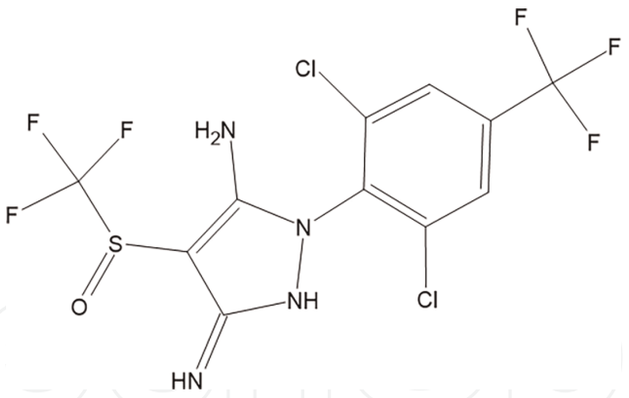

Figure 17.
Fipronil.

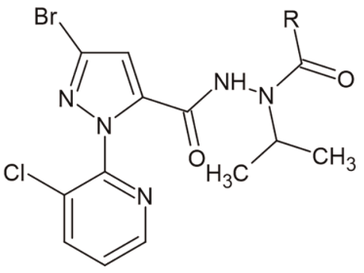

Figure 18.
Pyrazole derivative.

DOI: http://dx.doi.org/10.5772/intechopen.108764

3. Conclusion

Pyrazole nucleus and its various derivatives have been studied extensively in the past and found to be effective in a variety of pharmacological and pathological conditions. Its structure allows for numerous applications in fields such as technology, medicine, and agriculture. In the agrochemical industry, pyrazole derivatives, in particular, have a long history of use as herbicides, insecticides, fungicides, and acaricides. We have covered a variety of pyrazole-related synthetic strategies and biological applications in this chapter. Even though a wide variety of pyrazole synthesis techniques have been developed by organic chemists, and new techniques are continually being developed, the creation of novel, regioselective pyrazole-forming processes remains an exciting area of study. This chapter serves as a foundation and helps researchers to create novel synthetic approaches and potent new compounds.

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