JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Synthesis of Pyranopyrazoles using a Silica-Sodium Sulphate as a reusable catalyst in water

Aisha Siddekha,

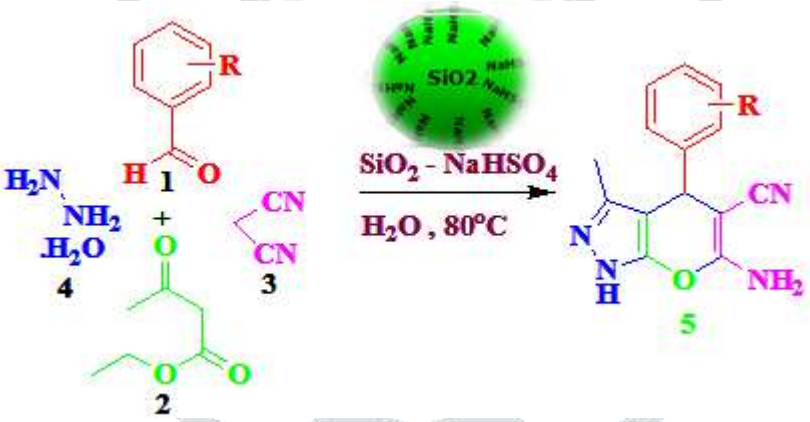
Assistant Professor

Department of Chemistry

[1] Government First Grade College, Vivekanandanagar, Tumkur-572102, Karnataka, INDIA.

[1]aishasiddekha@gmail.com, [1]Ph: 91-9880687850

Abstract: In this study, a one-pot four component synthesis of pyranopyrazoles from araldehydes (1), ethyl acetoacetate (2), malononitrile (3) and hydrazine hydrate (4) in the presence of catalytic amounts of heterogeneous silica-sodium hydrogen sulphate in water as a medium has been descrided. The ability to reuse the catalyst and good yields of the products are the important features of this method.



Index Terms **- Multi-component reactions, Pyranopyrazoles, Heterogeneous catalysts, Silica-sodium hydrogen sulphate**

1. INTRODUCTION

In the recent past Multicomponent reactions have gained higher priority due to high atom economy, milder reaction conditions and selectivity, with least byproduct formation as compared to conventional multistep synthetic reactions. simpler experimental procedures, efficient and recyclable catalysts, lower energy consumptions make these reactions more attractive, making them greener options for synthesis of many heterocyclic organic compounds such as substituted quinolines, benzopyrans, pyranopyarazoles etc.

Pyranopyrazoles are an important class of heterocyclic compounds which find application as pharmaceutical and biodegradable agrochemicals [1-3]. These compounds have been prepared earlier by a three component reaction between pyrazolone, aromatic aldehyde and malononitrile using triethylamine as catalyst in ethanol [3] and by the reaction of 5-methyl-2,4-dihydro-3*H*-pyrazol-3-one, malononitrile and different aromatic aldehydes using ammonium acetate in ethanol [4]. A four component reaction of aldehydes, ethyl acetoacetate, malononitrile and hydrazine hydrate using cyclodextrin has also been reported [5]. Continuing our research work in green synthesis of biologically important organic molecules [6] using green chemistry principles we are reporting a synthesis of Pyranopyrazoles using silica-sodium hydrogen sulphate as heterogeneous catalyst.

Advantages of solid catalysts include the safer handling, regeneration, and disposal complying with the green chemical principles making them very attractive for the researchers. Heterogeneous catalysts like SiO_2-$NaHSO_4$ catalyzed organic reactions havegained much attention due to their high catalytic activity, versatility of catalyzing many reactions, easier preparation, handling, stability and recyclability. Das B. *et. al.* [7] have used silica supported sodium hydrogen sulphate to synthesize 1, 8-Dioxo-octahydroxanthenes from 5, 5-dimethyl-1,3-cyclohexanedione and aromatic aldehydes in acetonitrile. Sodium hydrogen sulphate and sodium nitrite in the presence of SiO_2 has been used as an oxidizing agent for the conversion of aryl substituted unsaturated acylhydrazides to their corresponding azo compounds at room temperature [8]. Comparing the catalytic activity of pure $NaHSO_4$with that of SiO_2-$NaHSO_4$ shows that the latter is better than the pure compound itself in catalytic activity as product yields were good (**Table 1**). The catalyst was prepared [9] and used in a model reaction using anisaldehyde as the starting material.

2. Experimental

All chemicals used were commercial and without further purification. Progress of the reaction was monitored using Silica gel-G TLC plates. The synthesized compounds were characterized by 1H NMR spectral analysis, comparing the products on TLC or by the comparison of melting points with products prepared by known methods. NMR spectra were recorded on a Brucker spectrophotometer. FT-IR spectra were recorded on a Bruker Optics Alpha-P FT-IR spectrophotometer with attenuated total reflectance (ATR) module.

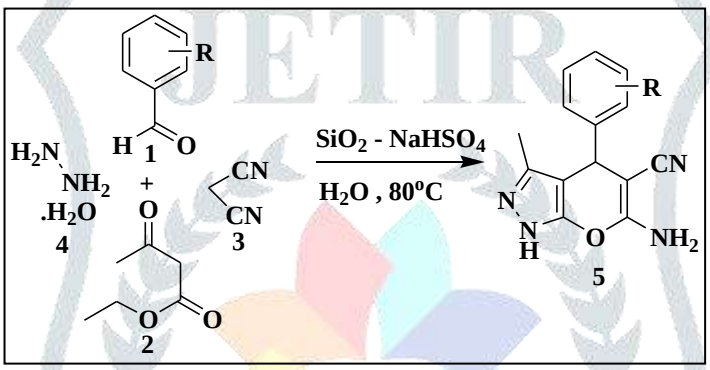
2.1. Preparation of catalyst

Silica gel (1.5 g, 60-120 mesh) $NaHSO_4$ (0.7 g, 5 mmol) were taken in 10 mL of water, stirred for approximately 1 hour. This was heated at 120 ºC for 2-3 hour and dried to get free flowing solid powder of SiO_2-$NaHSO_4$.

In order to recycle the catalyst, after the completion of the reaction and removal of the product, ethyl acetate (10 mL) was added to the reaction mixture and the catalyst was filtered and washed with ether which was ready for further use. It was used up to 3-4 times after which the catalytic activity was found to be decreased, which may be due to the degradation of the catalyst under mechanical stirring and heating. The yields for the four runs were found to be 93%, 90%, 75% and 60% respectively indicating the degradation of the catalyst. The catalyst was successfully applied to the reactions with various araldehydes using ethylacetoacetate, malononitrile and hydrazine hydrate and the results are presented in **Table 1**.

2.2. Typical Procedure for the preparation of pyranopyrazole

The aromatic aldehyde (1 m mol), malononitrile (1 m mol), ethyl acetoacetate (1 m mol) hydrazine hydrate (1 m mol) and catalyst SiO_2-$NaHSO_4$ (0.5 m mol) were taken in water (~5 ml) and heated at 80 ºC for 20–30 minutes. Products were subjected to column chromatography to get pure compounds. Various aromatic aldehydes were used, the yield of the products and time taken for completion of the reactions are summarized in **Table 1**. The reactions are compatible with functional groups such as -Cl, -OCH_3, -NO_2 and -OH. Spectral data (IR and 1H NMR) of the compounds prepared are given in Figure 1 to 7.



Scheme 1: Synthesis of Pyranopyrazoles

TABLE 1: Synthesis of pyranopyrazoles from aromatic aldehydes.

Sl. No.	Aromatic aldehyde	Product	Time (min)	Yield (%)
1	Anisaldehyde	5a	30	95
2	3-methoxy, 4 –hydroxybenzaldehyde	5b	30	90
3	3- Nitrobenzaldehyde	5c	30	85
4	4- Nitrobenzaldehyde	5d	30	80
5	4-Chlorobenzaldehyde	5e	30	89
6	N,N-Dimethylbezaldehyde	5f	30	80

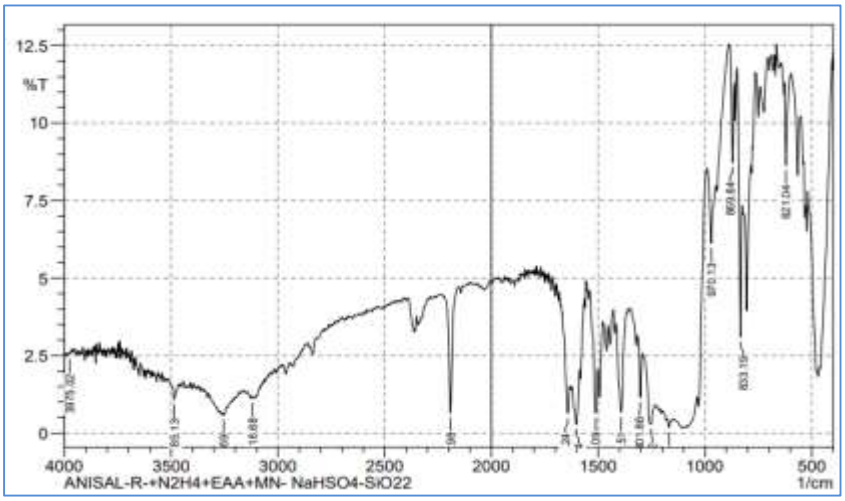
4. Conclusions

In this study we have reported the versatile nature of SiO_2-$NaHSO_4$ as a heterogeneous, inexpensive and efficient catalyst for the synthesis of pyranopyrazoles under mild reaction conditions. The method reported here is environmentally benign, absence of any organic solvents, and involves simple reaction set-up not requiring specialized equipment. It gives excellent product yieldsin a short reaction time making it a 'Green Protocol's for the synthesis of bioactive Pyranopyrazoles via the one-pot four component reaction of araldehydes, ethylacetoacetate, malononitrile and hydrazine hydrate.

References

[1] Junek, H.; Aigner, H. *Chem. Ber*. **1973**, 106, 914.
[2] (a) Wamhoff, H.; Kroth, E.; Strauch, K. *Synthesis*, **1993**, 11, 1129; (b) Tacconi, G.; Gatti, G.; Desimoni, G. *J. Prakt. Chem*. **1980**, 322, 831; (c) Sharanin, L. G.; Marshtupa, V. P.; Sharanin Yu, A. *Khim. Geterosikl. Soedin*. **1980**, 10, 1420.
[3] Sharanin Yu, A.; Sharanina, L. G.; Puzanova, V. V. *Zh. Org. Khim*. **1983**, 19, 2609.
[4] Nadia, M. R; Nahed, Y. K.; Fahmyb, A, F.; El-Sayeda, A. A. Der Pharma Chemica, 2, **2010**, 400.
[5] Vasuki, K.; Kandhasamy, *TetrahedronLett*. 49, **2008**, 563.
[6] Siddekha, A; Nizam, A; Pasha, M. A. *Spectrochim. ActaA Mol. Biomol. Spectrosc*.81, **2011**, 431.
[7] Das B, Thirupathi P, Reddy KR, Ravikanth B, Nagaraju L, *Catal. Commun*., **2007**, 5.
[8] Li XC, Wang YL, Wang JY, *Synth. Commun*., **2002**, *32*, 2791.
[9] Azarifar D, Forghaniha A. *J Chin Chem Soc*, 2006, **53**: 1189

Supporting data – Infra red and ^{1}H NMR of some of the compounds prepared-



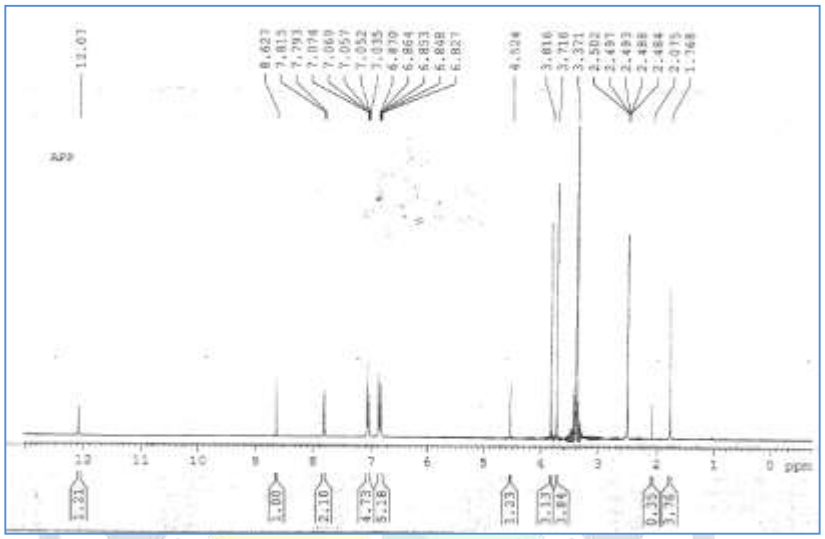


Fig. 1 and 2- IR and ^{1}H-NMR of 6-Amino-4-(4-methoxyphenyl)-5-cyano-3-methyl-1-phenyl-1,4-dihydropyrano[2,3-c] pyrazole.

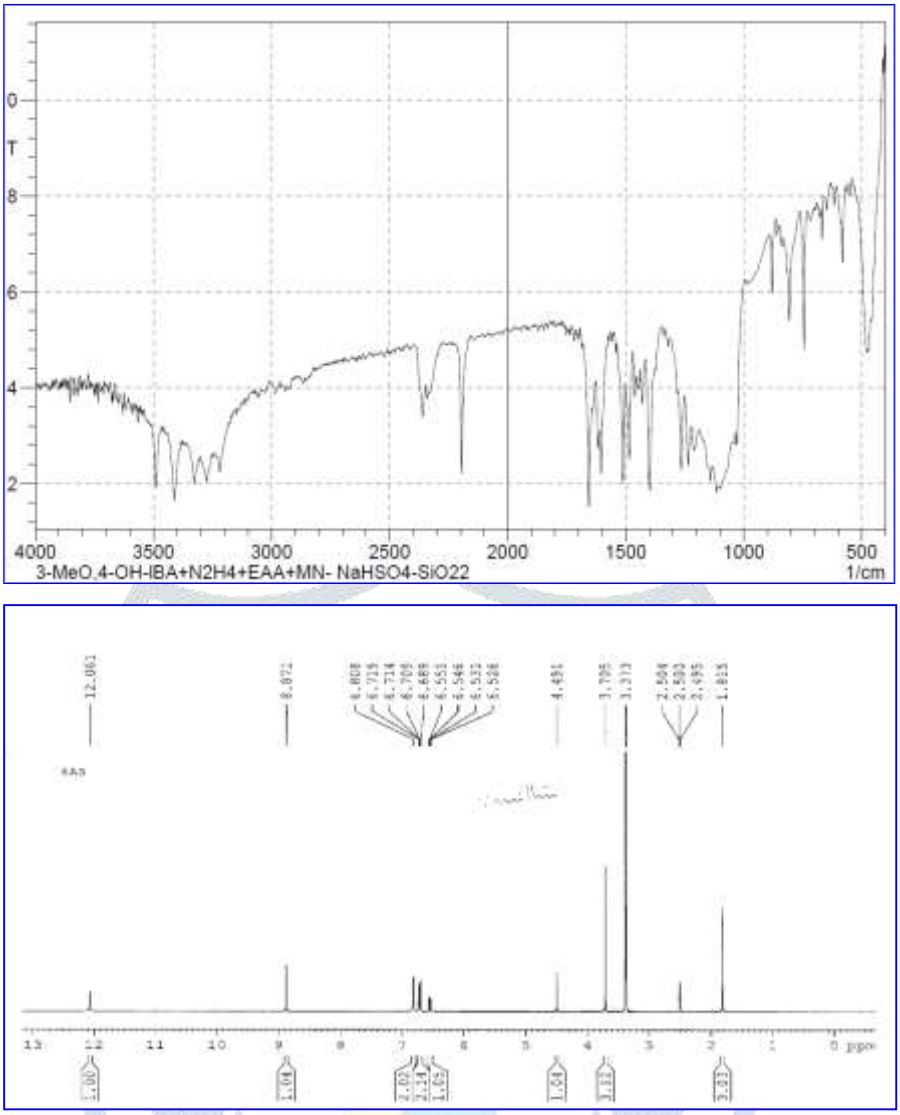


Fig. 3 and 4- IR and ^{1}H-NMR of 6-Amino-4-(4′-hydroxy-3′-methoxyphenyl)-3-methyl-1,4-dihydropyrano[2,3-c]pyrazole-5- carbonitrile

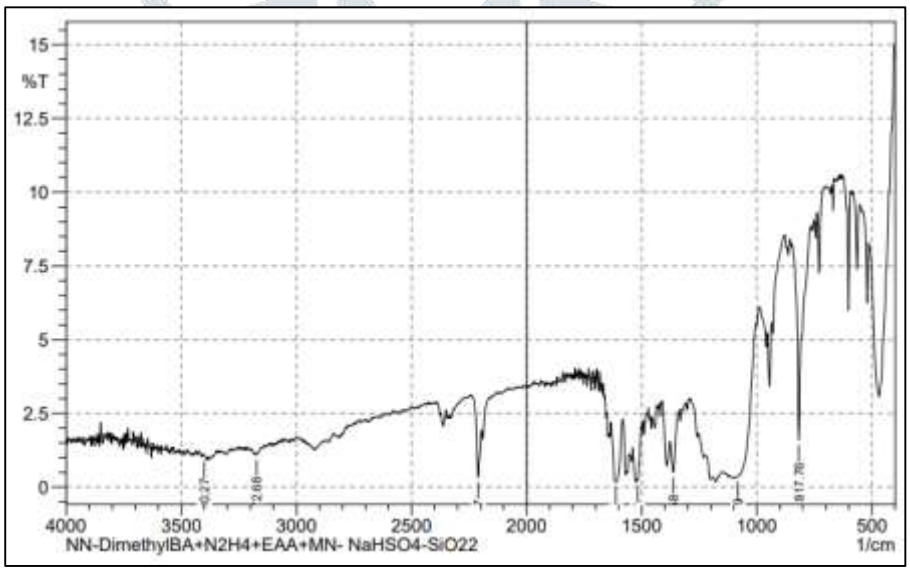


Fig. 5. IR of 6-Amino-4-(N, N- dimethyl)-3-methyl-1,4-dihydropyrano [2,3- *c*]pyrazole-5- carbonitrile

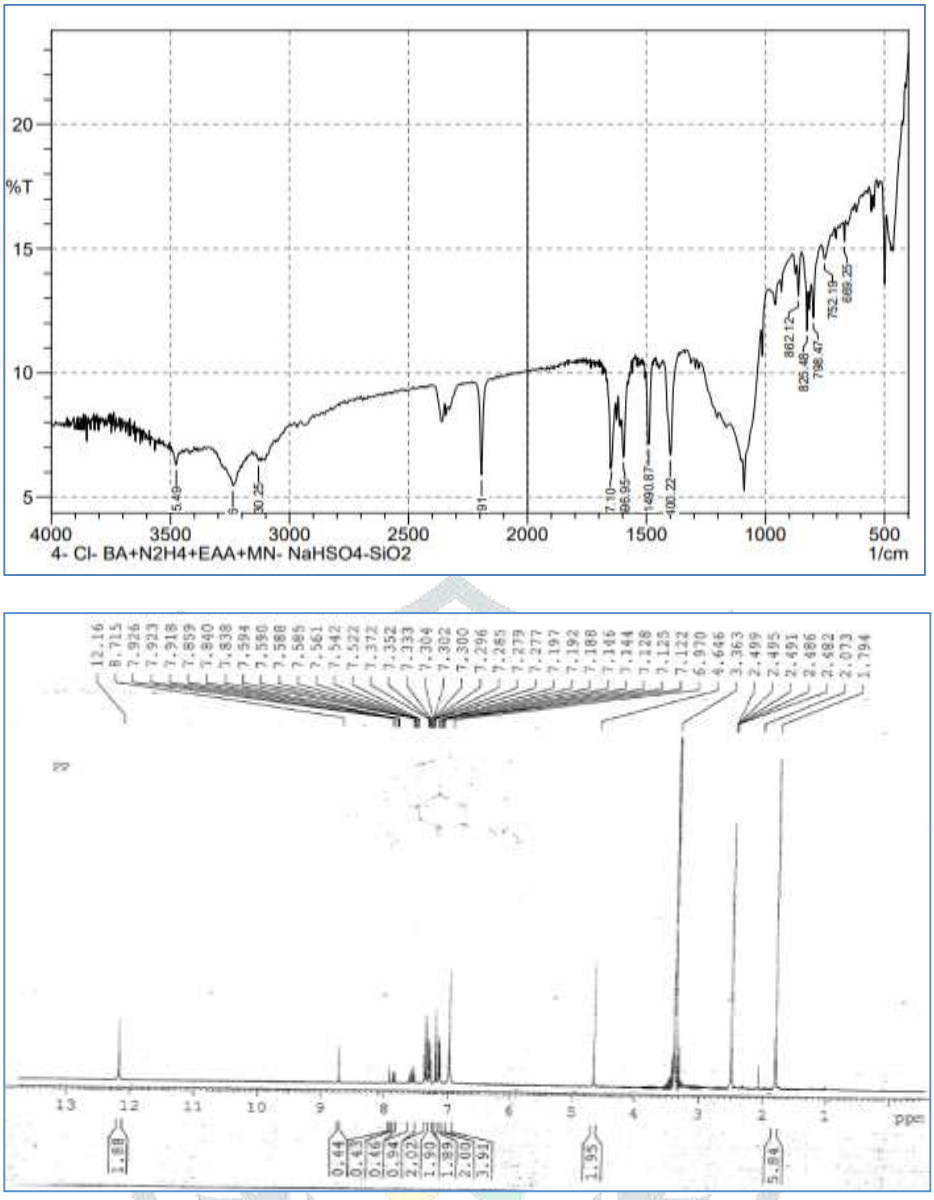


Fig. 6 and 7- IR and ^{1}H-NMR of 6-Amino-4-(4′-chloro)-3-methyl-1,4-dihydropyrano [2,3- *c*]pyrazole-5- carbonitrile