International Journal of Scientific Research in Chemistry (IJSRCH)
© 2020 IJSRCH | Volume 5 | Issue 1 | ISSN : 2456-8457

Efficient and Environmentally Benign Synthesis of Quinoxaline Catalysed by Fruit Juice

Anis Ahmed Sheikh*[1], Patel Shaukat Karimkha[2], Sayyad Sultan Kasim[1]

[1]Department of Chemistry, Maulana Azad College of Arts, Science and Commerce, Aurangabad, Maharashtra, India

[2]Department of Industrial Chemistry, Adarsh Senior College, Omerga Dist, Osmanabad, Maharashtra, India

ABSTRACT

Quinoxaline is one of the most important nitrogen heterocycle having diverse applications in medicinal field. In spite of importance of several methodologies proposed by researchers these methods are still having some limitations in view of green chemistry principles. In this research paper we have proposed the efficient and environmentally benign orange juice catalysed green synthesis of Quinoxaline. The condensation of 1,2 dicarbonyl compound with 1.2 diamine has been carried out in presence of orange juice and the results obtained are tabulated. The mild reaction, short reaction time, easy work and good to excellent yield are some salient features of this protocol.

Keywords: Benzene 1,2 Diamine,1,2 Dicarbonyl Compounds , Orange Juice

I. INTRODUCTION

Quinoxaline is one of the most important nitrogen heterocycle also known as benzopyrazine having benzene ring attached to pyrazine nucleus. Quinoxaline and its derivatives are found to have diverse medicinal applications such as cytotoxic, antibacterial, anticonvulsant, antioxidant, anti-inflammatory, antimalarial, antitubercular anticancer and antidepressant. The quinoxaline moiety is found in many medicinally important drugs such as actinoleutin, echinomycin and levomycin. It is noteworthy the simple structure and vast applications of quinoxaline attracted the attention of researchers for its synthesis .The pharmaceutically important drugs containing quinoxzaline moiety are shown in figure1.

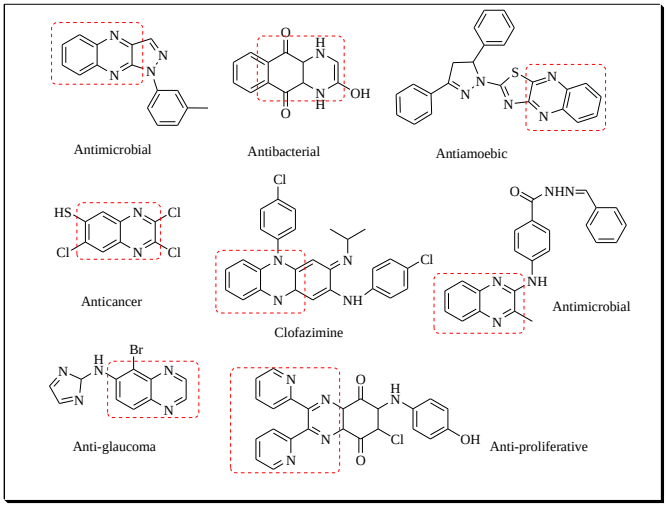
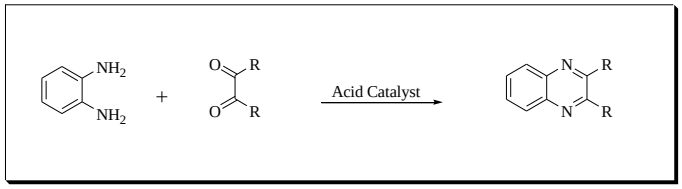


Figure 1. Biologically Active Compounds Containing Quinoxaline Moiety

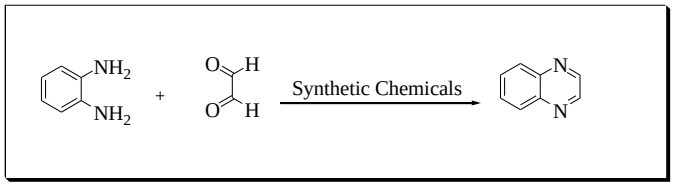
The synthesis of heterocyclic compounds through novel methods remains the most important issue for organic chemist. This is the reason several researchers have proposed the various methods for quinoxaline synthesis. The most familiar and conventional

method is the condensation of 1,2 diamine with 1,2 dicarbonyl in presence of acid which results in formation of quinoxaline. (Scheme 1.)



Scheme 1. Acid Catalysed Quinoxaline Synthesis

In addition to above method other methods for catalytic quinoxaline synthesis includes $CeCl_3.7H_2O$ catalysed, Amberlyte catalysed, Cu-catalysed, $Ga(ClO_4)$ catalysed, Montmorillonite K-10 catalysed, heteropolyacid catalysed, sodium hexafluorophosphate catalysed, TMSCl-water catalysed synthesis. (Scheme 2)



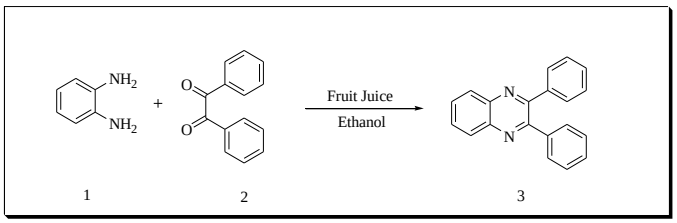
Scheme 2. Synthesis of Quinoxaline via Synthetic Chemicals as Catalyst

In spite of importance of above synthetic methodologies these are still suffering from some limitations such as use of toxic chemicals and metallic compounds as catalyst, , inexpensive catalyst, longer reaction time, tedious work up and low yield. The fruit juice catalysed organic synthesis is cost effective and eco-friendly as proposed by Anis Ahmed et.al. Therefore in order to overcome from these limitations we have introduced the orange juice catalysed synthesis of quinoxaline. The orange fruit being naturally available, inexpensive, non hazardous and easily available. The pH of orange juice near about 4-5 is suitable for acting as acid catalyst. The solubility of orange juice in almost all the solvents is specific feature of this catalyst.

II. METHODS AND MATERIAL

Initially we have performed the reaction between 1,2 dicarbonyl compound (1) and 1,2 diamine(2) in presence of pineapple, apple and orange juice in ethanol to produce the quinoxaline (3) (Scheme3). The reaction optimisation in different juices has been carried out to determine the efficiency of orange juice. After screening of fruit juice catalysed synthesis of quinoxaline, the results obtained are shown in table1. The orange juice catalysed synthesis is more efficient than pineapple and apple juices.

After screening it is revealed that the orange juice is the suitable catalyst in context to reaction time and yield. The orange juice has been used as suitable catalyst for further synthesis of substituted quinoxaline.



Scheme 3. Fruit Juice Catalysed Synthesis of Quinoxaline

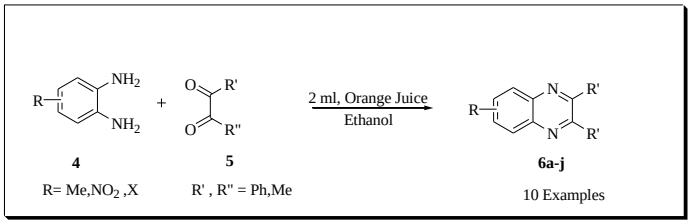
Table 1. Screening of Fruit Juices for Synthesis of Quinoxaline

Entry	Catalyst	Quantity in ml	Solvent	Time in hour	Yield %
1	Pineapple Juice	0.5	EtOH	08	47
2	Pineapple Juice	1	EtOH	6.5	61
3	Pineapple Juice	2.0	EtOH	06	73
4	Orange Juice	0.5	EtOH	06	61

5	Orange Juice	1	EtOH	05	77
6	**Orange Juice**	**2**	**EtOH**	**03**	**92**
7	Apple Juice	0.5	EtOH	07	54
8	Apple Juice	1	EtOH	06	72
9	Apple Juice	2	EtOH	5.4	79
10	Without Catalyst	-	EtOH	09	56

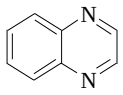
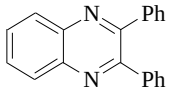
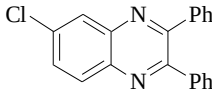
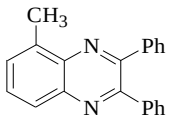
III. RESULTS AND DISCUSSION

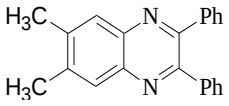
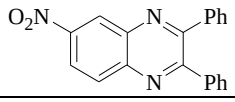
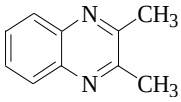
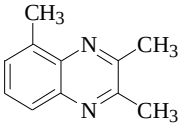
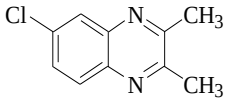
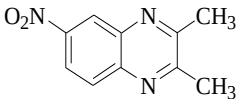
In our continuous investigation of Lemon juice catalysed synthesis of Pyrrole we have introduced the orange juice catalysed synthesis of quinoxaline in ethanol.(Anis Ahmed et.al.) The chemical compositions of orange juice consist of organic acids, sugars and phenolic compounds. The common organic acids are citric acid, ascorbic acid and malic acids. The orange juice being naturally available, non hazardous ,eco-friendly and soluble in almost all solvents acts as green catalyst. These specific features of orange juice are sufficient to acts as suitable catalyst for acid catalysed organic transformations. Initially we have screened the quinoxaline synthesis by different fruit juices and then we have selected the 2 ml orange juice as catalyst due to excellent yield and less reaction time.(Entry 6,Table .1) By selecting this combination of catalyst and solvent, we have synthesised the substituted quinoxaline and results obtained are tabulated in table2.(Scheme 4)



Scheme 4 : Orange Juice Catalysed Synthesis of Quinoxaline

Table 2

Entry	Product	Time in hour	Yield	M.Pt.(^{0} C)
6a		04	83	123-127
6b		03	91	109-113
6c		4.3	85	113-117
6d		02	91	153-158

6e		1.5	93	167-172
6f		05	63	183-187
6g		3.4	82	103-107
6h		03	91	121-125
6i		04	89	119-24
6j		06	67	179-183

IV.CONCLUSION

In conclusion the orange juice catalysed synthesis of quinoxaline and its derivatives is found to be eco-friendly and environmentally benign as compare to synthetic chemicals catalysed protocols. This protocol is inexpensive and environmentally non hazardous as the orange juice is naturally available, non hazardous, soluble in almost all solvents and excellent yield is obtained. Moreover this green protocol is an alternative to tedious work up procedures.

V. EXPERIMENTAL SECTION

All the chemicals were purchased from Sigma-Aldrich and SD-Fine brands. All the solvents and reagents were used without further purification. The reactions were monitored by thin layer chromatography. Melting points were determined in open capillary tube and uncorrected. The ^{1}HNMR spectra were recorded on 400 MHz frequency using tetramethyl silane as reference compound. ^{13}CNMR data recorded on 100 MHz frequency.

(i) Preparation of Orange Juice

Fresh oranges of Citrus reticulate species were purchased from market and small pieces were made. After that the juice was extracted from these pieces through juicer and filtered to get the pure orange juice.

(ii) General Procedure for Synthesis of Quinoxaline

In a 50ml round bottom flask o-phenylenediamine (4a-j, 0.02 mole) and 1,2 dicarbonyl compound (5a-j,0.02 mole) and 2 ml orange juice in 10 ml of ethanol were taken and stirred for particular time. After completion of reaction as shown by TLC, the reaction mixture was poured in cold water, which produced the precipitate. The filteration and washing of this precipitate results in formation of final product which was further recrystallised from ethanol to yield the pure product.(6a-j)

(iv) Spectral Data of Synthesised Quinoxaline Compounds

Quinoxaline (6a)

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.83-7.93(m, 2H), 8.13-8.15 (m, 2H).8.81 (s, 2H).^{13}C NMR (100MHz, $CDCl_3$): δ 129.3, 129.7, 141.9, 144.7

VI. REFERENCES

[1]. S. Srivastava, J. Banerjee, N. Srestha. (2014).IOSR Journal Of Pharmacy. 4(12),17-27.

[2]. A. Hasaninejad, A. Zare, M.R. Mohammadizadeh, M. Shekouhya (2008) ARKIVOC xiii, 28-35.

[3]. S. Rong, X.Yu, W. Qinjie, X. Qing,Y. Qiaojun, H. Bo, H. Yongzhou. (2007). Drug Discov. Ther.1(2),119-123.

[4]. M.M. Hossain, M.H. Muhib, M.R. Mia, S. Kumar, , S.A. Wadud. (2012).Bangladesh Med Res Counc Bull.(38).47-50

[5]. A.F. Crowther, F.H.S. Curd, D.G.Davey, G.J. Stacey. (1949).Chem. Soc. 1260-1262.

[6]. J.B. Rangisetty, C.N. Gupta, V.H. Prasad, A.L. Srinivas, P. Sridhar, N. Parimoo, Veeranjaneyulu, P.(2001).A. J. Pharmacy, Pharmacology. 53, 1409 -1413.

[7]. D.P. Singh, S.R. Hashim, R.G.Singhal (2010). International Journal of Drug Development & Research 2(4),187.

[8]. M. Alswah, A. Ghiaty, A. El-Morsy, K. El-Gamal. (2013).Hindawi Publishing Corporation. http://dx.doi.org/10.1155/2013/587054

[9]. V.K. Tandon, D.B. Yadav, H.K. Maurya, A.K. Chaturvedi, P.K. Shukla. (2006). Med. Chem.14, 6120-6126. DOI: 10.1016/j.bmc.2006.04.029

[10]. S. Biswas, S.Batra. (2013). European Journal Organic Chemistry. 4895–4902.

[11]. Anis Ahmed Sheikh et al. Int. J. S. Res. Sci. Engg. Technol. September-October- 2018; 4(10): 176-180

[12]. Tai-kun Huang, Rui Wang, Lin Shi, Xiao-xia Lu. (2008).Catalysis Communications. 9, 1143–1147

[13]. P. Ghosh, A. Mandal. (2012).Tetrahedron Lett. 53,6483-6488.

[14]. F.W. Wu, R.S. Hou, H.M. Wang, I. J. Kang, L.C.Chen. (2011) Heterocycles.. 83, 2313-2320.

[15]. S. S. Kasim, S. Fazil, A. A. Sheikh.(2018) Int. Jour. of Res. Cult. Soc. 2.2, 31-35

[16]. D.Q., Shi, G.L. Dou, (2008). Synth. Commun. 38, 3329.

Cite this article as :

Anis Ahmed Sheikh, Patel Shaukat Karimkha, Sayyad Sultan Kasim, "Efficient and Environmentally Benign Synthesis of Quinoxaline Catalysed by Fruit Juice", International Journal of Scientific Research in Chemistry (IJSRCH), ISSN : 2456-8457, Volume 5 Issue 1, pp. 01-05, January-February 2020.

URL : http://ijsrch.com/IJSRCH19464