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Synthesis of Quinazolin-4(3*H*)-one Derivatives Using Heteropolyacids as Heterogeneous and Recyclable Catalysts

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A highly efficient and simple procedure for the synthesis of quinazolin-4(3*H*)-ones from the condensation of 2-aminobenzamide with triethylorthoesters in presence of a catalytic amounts of heteropolyacids in various solvents is reported.

Key Words: Quinazolinones, Recyclable catalysts, Heteropolyacids, Heterogeneous.

INTRODUCTION

Solid acids have attracted much attention in organic synthesis owing their easy work-up procedures, easy filtration and minimization of cost and waste generation due to reuse and recycling of these catalysts[1].

The application of heteropolyacids as catalytic materials is growing continously in the catalytic field. These compounds possess unique properties such as well-defined structure, Brönsted acidity, possibility to modify their acid-base and redox properties by changing their chemical composition (substituted heteropolyacids), ability to accept and release electrons, high proton mobility, ease of reusability and excellent thermal and chemical stability, *etc*.[2]. Because of their stronger acidity, they generally exhibit higher catalytic activity than conventional catalysts such as mineral acids, ion exchange resins, mixed oxides zeolites, *etc*.[3]. In view of green chemistry, the substitution of harmful liquid acids by solid reusable heteropolyacids as catalyst in organic synthesis is the most promising application of this acids.

Quinazolin-4-ones and their polycyclic derivatives are a very important class of heterocycles with a wide range of pharmacological and biological activities. They are finding numerous new applications and widely used as conteraceptive[4], antitumor[5,6], antihistamine[7,8], anticonvulsant[9], antiviral[10] and antimalaria[11].

In spite of their importance from a pharmaceutical, industrial and synthetic point of view, comparatively few methods for their preparation are reported in the literature. A number of synthetic methods reported in the literatures, include condensation reactions of 2-aminobenzamide derivatives with carboxylic acids[12], condensation of *o*-acyl-aminobenzoic acids with amines[13], reaction of benzoxazinone with aromatic[14], aliphatic[15] and heterocyclic amines[16] and photochemicals methods[17].

Many of these processes suffer from some limitations such as drastic reaction conditions, expensive reagents, low to moderate yields, relatively long reaction times and the occurrence of several side reactions. So, the development of simple, efficient, clean, high-yielding and environmentally friendly approaches is desirable. It is therefore of interest to examine the behaviour of some heteropolyacids as catalyst in various solvents for the synthesis of quinazolin-4-one derivatives. To the best of our knowledge, cyclocondensation of 2-aminobenzamide with triethylorthoesters in presence of a catalytic amount of heteropolyacids in various solvents for the synthesis of quinazolin-4-one derivatives has not yet been reported in literature. Herein we report the use of some heteropolyacids in various solvents for synthesis of quinazolin-4-one derivatives.

During the course of our studies towards the development of new routes to the synthesis of heterocyclic compounds[18,19] and using heteropoly acids as green and recyclable catalysts[20], herein we report the synthesis of quinazolin-4-one derivatives using heteropolyacids as a catalyst.

Initially, in order to find the optimal conditions, the reaction of 2-aminobenzamide (0.01 mol) and triethylorthoformate (0.015 mol) in the presence of various amount of $H_{14}[NaP_5W_{30}O_{110}]$

in *p*-xylene used as a model reaction. The best result have been obtained at 0.15 mol % of catalyst. However, regarding the green chemistry, ethanol is also a good choice as a solvent. To show the generality of this method the optimized system used for the synthesis of the quinazolin-4(3*H*)-one derivatives by cyclization of 2-aminobenzamide and triethylorthesters in the various of solvents *i.e.*, *p*-xylene, *n*-hexane, cyclohexane, toluene, ethanol, chloroform and solvent-free system (Table-1) and the presence of catalytic amount of various type of heteropolyacids including, $H_3[PW_{12}O_{40}]$, $H_3[PMo_{12}O_{40}]$, $H_4[SiW_{12}O_{40}]$, $H_6[P_2W_{18}O_{62}]$, $H_{14}[NaP_5W_{30}O_{110}]$ (Table-2).

TABLE-1
SYNTHESIS OF QUINAZOLINE-4(3*H*)-ONE USING $H_{14}[NaP_5W_{30}O_{110}]$ IN DIFFERENT SOLVENTS

Entry	Solvent	Time (min)	Yield (%)
1	*p*-Xylene	18	92
2	*n*-Hexane	22	91
3	CycloHexane	22	92
4	Toluene	25	87
5	Ethanol	30	88
6	Chloroform	30	87
7	Solvent-free	33	82

TABLE-2
SYNTHESIS OF QUINAZOLINE-4(3*H*)-ONE USING VARIOUS HETEROPOLYACIDS IN *p*-XYLENE

Entry	Catalyst	Time (min)	Yield (%)
1	$H_{14}[NaP_5W_{30}O_{110}]$	18	92
2	$H_3[PW_{12}O_{40}]$	20	90
3	$H_4[SiW_{12}O_{40}]$	22	90
4	$H_6[P_2W_{18}O_{62}]$	25	89
5	$H_3[PMo_{12}O_{40}]$	28	87

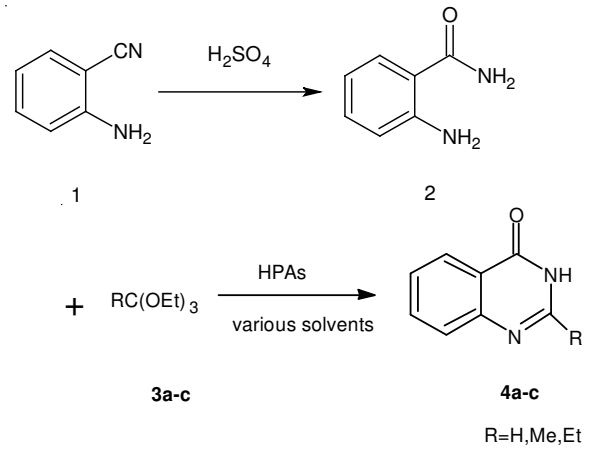
We also investigated the reusability of the catalyst. For this purpose after completion of the model reaction in refluxing *p*-xylene the mixture was filtrated and ethanol was added to the residue. The catalyst was not soluble in ethanol. So it could be separated by a simple filtration and washed with dichloromethane. The recycled catalyst was used for reaction with the same substrate without observation of appreciable loss in its catalytic activity. The results of the first experiment and subsequent experiments were almost consistent in yields (84, 81and 76%).

In this work, we investigated the synthesis of quinazolin-4(3*H*)-one derivatives (**4a-c**) through cyclocondensation of 2-aminobenzamide (**2**) with triethylorthoesters (**3a-c**) in the presence of a catalytic amount of heteropolyacids (HPAs) in various solvents (**Scheme-I**).

EXPERIMENTAL

All chemicals were obtained from Merck Company and used as received. $H_{14}[NaP_5W_{30}O_{110}]$ was prepared according to earlier works[21]. The Wells-Dawson $H_6[P_2W_{18}O_{62}]$ was prepared as described elsewhere[22] from an aqueous solution of α/β $K_6[P_2W_{18}O_{62}]\cdot 10H_2O$ salt, which was treated with ether and concentrated (37 %) HCl solution.

Melting points were recorded on an electrothermal type 9100 melting point apparatus. The IR spectra were obtained on a 4300 Shimadzu spectrophotometer as KBr disks. The ^1H NMR (100 MHz) spectra were recorded on a Bruker AC 100 spectrometer. All products gave satisfactory spectral data in accord with the assigned structures.



Scheme-I: Synthesis of quinazolin-4(3*H*)-ones **4a-c**

General procedure for the synthesis of quinazolin-4(3*H*)-ones (4a-c): A mixture of 2-aminobenzamide (**2**) (0.01 mol), triethylorthoesters (**3a-c**) (0.015 mol) and heteropolyacids (0.15 mol %) was refluxed in various solvents for 18-40 min. After completion of reaction (monitored by TLC MeOH:$CHCl_3$, 1:9) the reaction mixture was cooled and precipitate was filterated and washed with cold solvent. Prouducts were obtained in good yields.

Selected spectral data

2-Methyl-quinazolin-4(3*H*)-one (4b): m.p. 233 ºC (Lit.[23] 234 ºC); ^1H NMR (100 MHz, DMSO, δ ppm): 2.3 (s, 3H, CH_3), 7.3-8.2 (m, 4H, Ar), 11.8-12.4 (br, 1H, NH exchange with D_2O); IR (KBr, disc, ν_{max}, cm^{-1}): 1673 (C=O), 2916-3169 (NH).

RESULTS AND DISCUSSION

Reaction of 2-aminobenzonitrile (**1**) with H_2SO_4 gave 2-aminobenzamide (**2**). Treatment of **2** with triethylorthoesters (**3a-c**) under reflux in the presence of a catalytic amount of heteropolyacids (HPAs) in various solvents gave products which were identified as quinazolin-4(3*H*)-ones (**4a-c**) (**Scheme-I**). All products gave satisfactory spectral data inaccord with the assigned structures.

Conclusion

It should be noted that, this method is effective for the preparation of quinazolin-4(3*H*)-ones (**4a-c**) form reaction of 2-aminobenzamide (**2**) and triethylorthesters (**3a-c**). Comparison of the obtained results, show some advantages, using, $H_3[PW_{12}O_{40}]$, $H_4[SiW_{12}O_{40}]$, $H_{14}[NaP_5W_{30}O_{110}]$. They are more effective catalysts than other heteropolyacids (Table-2) and nonpolar solvents such as *p*-xylene is the solvent of choice for the synthesis of quinazolin-4(3*H*)-ones *via* condensations of 2-aminobenzamide with triethylorthesters using heteropolyacids as green recyclable and heterogeneous catalysts.

REFERENCES

1. M.H. Alizadeh, H. Razavi, F.F. Bamoharram and K. Daneshvar, *J. Mol. Catal. A: Chem.*, **206**, 89 (2003).
2. L.E. Briand, G.T. Baronelti and H.J. Thomas, *Appl. Catal. A: Gen.*, **256**, 37 (2003).

3. M.A. Schwegler, H. van Bekum and N. Munck, *Appl. Catal*., **74**, 191 (1991).
4. V.K. Pandey and H.C. Lokani, *J. Indian. Chem. Soc.*, **56**, 915 (1979).
5. Y. Shi, C. Ma and R. Zhang, *J. Organomet. Chem*., **691**, 1661 (2006).
6. S.-L. Cao, Y.-P. Feng, Y.-Y. Jiang, S.-Y. Liu, G.-Y. Ding and R.-T. Li, *Bioorg. Med. Chem. Lett*., **15**, 1915 (2005).
7. M. Akazome and T. Kondo, *J. Org. Chem.*, **58**, 310 (1993).
8. N.S. Cho, K.Y. Song and C. Parkanyi, *J. Heterocycl. Chem*., **26**, 1807 (1989).
9. G. Subrahmanyam and T. Duttaroy, *Tetrahedron*, **26**, 317 (1973).
10. A.F. Pozharskii and A.A. Konstantinchenko, *Khim. Geterotsikl. Soedin*., **7**, 46 (1979).
11. B.R. Baker, R.E. Schaub and J.B. Joseph, *J. Org. Chem*., **18**, 133 (1953).
12. R.H. Foster and N.J. Leonard, *J. Org. Chem*., **44**, 4609 (1979).
13. M.J. Kornet, *J. Pharm. Sci*., **67**, 1471 (1978).
14. M.A.F. Elaschef and M.E.A. Mageid, *Chem. Commun*., **39**, 287 (1974).
15. M.F. Ismail, N.A. Shams and M.R. Salem, *J. Org. Chem.*, **48**, 415 (1983).
16. P. Molina, A. Arques, I. Cartagena, J.A. Nogueva and M.V. Valcarcel, *J. Heterocycl. Chem.*, **20**, 983 (1983).
17. I. Ninomiga and O. Yamoto, *Heterocycles*, **40**, 475 (1976).
18. M.M. Heravi, K. Bakhtiari, Z. Daroogheha and F.F. Bamoharram, *Catal. Commun.,* **8**, 1991 (2007).
19. M.M. Heravi, R. Motamedi, N. Seifi and F.F. Bamoharram, *J. Mol. Catal. A. Chem*., **249**, 1 (2006).
20. M.M. Heravi, K. Bakhtiari, A. Fatehi and F.F. Bamoharram, *Catal. Commun*., **9**, 289 (2008).
21. F.F. Bamoharram, M.M. Heravi, M. Roshani, M. Jahangir and A. Gharib, *Appl. Catal.*, **302**, 42 (2006).
22. G.T. Baronetti, L. Briand, U. Sedran and H. Thomas, *Appl. Catal. A: Gen.*, **172**, 265 (1998).
23. A. Buzas and C. Hoffmann, *Bull. Soc. Chim. France*, 1889 (1959).