ISSN: 0974 - 7516 Volume 11 Issue 2

Organic CHEMISTRY

An Indian Journal

Full Paper

OCAIJ, 11(2), 2015 [066-069]

A convenient synthesis of azlactone derivatives catalyzed by scolecite zeolite

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ABSTRACT

A simple and efficient procedure for the synthesis of 4-Arylidene-2-phenyl-5(4)-oxazolones (Azlactone) derivatives through the condensation of aromatic aldehydes and hippuric acid in acetic unhydride medium at 70°C is described. The reaction goes smoothly. Simple experimental procedure, easy work- up and good yield of the products are the advantages of the present work.

KEYWORDS

Scolecite zeolite;
Catalyst;
Heterogeneous;
Azlactone;
Recyclability.

INTRODUCTION

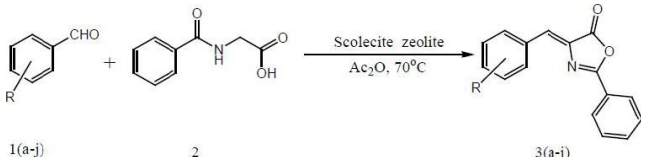
4-Arylidene-2-phenyl-5(4)-oxazolones are important synthons for the synthesis of several biologically active molecules[1]. It is also used as precursors for the synthesis of aminoacid[2,3], peptides[4], heterocycles[5,6], biosensors[7,8], and anti-tumor[9,10] or anticancer[11,12] compounds. Development of facile and environmentally friendly synthetic methods for azlactones constitutes an active area of investigation.

Due to their widespread applicability, research are continued to search new methods which is most suitable in terms of pollution abatement, yield and time. Generally azlactones are synthesized by Erlenmeyer method, which involve the direct condensation of aldehydes with hippuric acid in the presence of stoichiometric amounts of fused anhydrous sodium acetate as a basic catalyst in acetic anhydride[13]. Recently, some new reagents have become available for the synthesis of azlactones, such as Al_2O_3-H_3BO_3[14], supported KF[15], $Bi(OAc)_3$[16], $Bi(OTf)_3$[17], $ZnCl_2$[18], and $Ca(OAc)_2$[19]. Each method has its own merits but some need high temperature and is difficult to handle. Also some catalysts are homogeneous, needs tedious work-up procedure. However, the search continues in search of simple, mild, environmentally friendly and easy method for azlactones synthesis.

The use of acid catalysts is very common in the chemical, refinery industries and those technologies employing highly corrosive, hazardous and polluting liquid acids are being replaced with solid acids like clays, zeolites and metal oxide is desirable to achieve effective catalyst handling, product purification and to decrease waste production[20]. Recent decades have witnessed an exponential growth in the applications of heterogeneous catalysis to carry out synthetic transformations as a consequence of its significance in terms of enviro-economical and

practical aspects[21,22].

We have also described the applications of scolecite zeolite in the synthesis of 3,4-dihydropyrimidin-2(1H)-ones[23] 2,4,5-triarylimidazoles[24], 1,4-dihydropyrimidones[25], In continuation to our work on the heterogeneous catalysts, herein, we report a simple procedure for the synthesis of azlactones by condensing aromatic aldehydes with hippuric acid using scolecite zeolite.



Scheme 1

EXPERIMENTAL PROCEDURE

Melting points were determined in an open capillary in a paraffin bath apparatus and are uncorrected. The reactions were monitored by TLC and visualized with UV light. IR spectra were recorded on a matrix of KBr with FTIR-4100 (Jasco, Japan) spectrometer. ^{1}H NMR spectra were recorded on Varian NMR spectrometer, Model Mercury Plus (400 MHz) and the chemical shifts are given in ppm relative to TMS as an internal standard.

The naturally occurring scolecite zeolite is a calcium zeolite with NAT topology and an ordered (Si : Al) distribution. The chemical composition of natural scolecite (atom%) were Si, Al, Fe, Na, Ca and O in the ratio 16.03, 10.34, 0.03, 0.20, 7.05, 66.34 respectively. It was collected from the Ellora valley, Aurangabad (MS), Deccan traps of India. It was subsequently washed with distilled water and acetone for several times, dried and crushed into fine powder which was further washed with distilled water 3 - 4 times and dried at 110°C in an oven. The resulting sample was heated at 500 °C in high temperature muffle furnace (SONAR) for 1h at rate 3°C per minute. The sample was naturally cooled and used in organic synthesis.

General procedure

A dry 50 ml flask was charged with aromatic aldehyde (5 mmol), hippuric acid (5 mmol), acetic anhydride (15 mmol) and scolecite zeolite as a catalyst (200 mg). The mixture was stirred at 70°C for the time mentioned in TABLE 2. After completion of reaction (monitored by TLC) the hot solution of reaction mixture filtered to separate the catalyst then reaction mixture was cooled and 5 ml of 95% ethanol was added, and a yellow product was precipitated. The yellow solid was filtered off and washed with hot water. The crude azlactone was purified by recrystallization from ethanol to afford pure products.

Spectral data of representative compound

(a) 4-(4-chlorobenzylidene)-2-phenyloxazol-5(4*H*)-one

^{1}H NMR (DMSO, δ in ppm): 7.39-7.54 (m, 6H), 7.82 (d, 2H, 7.97 (d, 2H).

IR (KBr): 3342, 3079, 1751, 1606, 1562, 1484, 1418, 1309, 1178, 848, 721cm^{-1}.

RESULTS AND DISCUSSION

To investigate the optimum condition for reaction, we have carried out the condensation of 4-chlorobenzaldehyde with hippuric acid using acetic unhydride as a solvent in presence of different amounts of catalyst, such as 50, 100, 150, 200, 250 mg of scolecite zeolite, and it was found that 200 mg of catalyst was enough to accomplish the reaction with good yields (96%). Increasing the amount of catalyst did not obviously improve the yield (TABLE 1).

To check the activity of catalyst, we have carried out same reaction without catalyst but product yield was very less (35%) and consume much time also. It means that the catalyst play important role in

TABLE 1: Optimization of reaction condition

Sr.No.	Wt of catalyst (mg)	Time (min)	Yield (%)[a]
1	No catalyst	180	35
2	50	50	59
3	100	50	72
4	150	50	81
5	200	50	96
6	250	50	96

[a]Yield refers to isolated product.

TABLE 2 : Synthesis of 4-arylidene-2-phenyl-5(4)-oxazolone derivatives

Product	Aldehyde	Time (min)	Yield (%)[a]	Melting Point (°C)	
				Found	Reported
3a	C_6H_4CHO	30	89	167-168	168-169[26]
3b	4-MeC_6H_4CHO	30	93	142-143	143-144[26]
3c	4-$MeOC_6H_4CHO$	35	88	156-157	155-157[26]
3d	2-ClC_6H_4CHO	45	94	159-160	159-16[26]
3e	4-ClC_6H_4CHO	50	96	182-183	186-187[26]
3f	3-ClC_6H_4CHO	50	92	152-154	155[27]
3g	3-$NO_2C_6H_4CHO$	45	87	166-167	166-167[26]
3h	4-$NO_2C_6H_4CHO$	40	93	238-239	240-241[26]
3i	Furfural	40	90	168-169	170[14]
3j	Crotonaldehyde	45	92	152-153	152[14]

[a]**Yield refers to isolated product**

the reaction.

By encouraging this result, a wide variety of aromatic aldehydes condensed with hippuric acid in acetic unhydride medium. It was found that the reaction goes smoothly and gave the corresponding azlactones in good to excellent yields with catalyst. Moreover, all of benzaldehydes bearing electron-withdrawing groups, as well as electron-donating groups, gave good yield of products (TABLE 2).

For large scale and industrial processes recovery and reusability is important. So we have separated our catalyst from reaction mixture by filtering the reaction mixture in hot condition. It was washed subsequently with acetone, dried and reused for successive cycle and it was found that the catalyst is useful for several successive reaction without much more loss in its activity (TABLE 3).

TABLE 3: Recyclability of scolecite zeolite

Entry	Cycle	Yield (%)[a]
1	Fresh	96
2	First	96
3	Second	95
4	Third	94

[a]**Yield refers to isolated product**

CONCLUSION

In conclusion, we report here a scolecite zeolite is highly efficient for the synthesis of 4-arylidene-2-phenyl-5(4)-oxazolone derivatives. Aromatic aldehyde bearing electron-donating and electron withdrawing groups did not affect on yield of products and the catalyst is easily recycled and reuse for the four times without much loss in its activity.

REFERENCES

[1] K.Takenaka, T.Tsuji; J.Heterocycl.Chem., **33**, 1367 **(1996)**.

[2] J.T.Konkel, J.Fan, B.Jayachandran, K.L.Kirk; J.Fluorine Chem., **115**, 27 **(2002)**.

[3] K.Gottwald, D.Seebach; Tetrahedron., **55**, 723 **(1999)**.

[4] F.Caveller, J.Verducci; Tetrahedron Lett., **36**, 4425 **(1995)**.

[5] A.Avenoza, J.H.Busto, C.Cativiela, J.M.Peregrina; Tetrahedron Lett., **43**, 4167 **(2002)**.

[6] P.D.Croce, R.Ferraccioli, C.La-Rosa; J.Chem.Soc.Perkin Trand., **1**, 2499 **(1994)**.

[7] J.Penalva, R.Puchades, A.Maaquieira, S.Gee, B.D.Hammock; Biosens.Bioelectron., **15**, 99 **(2000)**.

[8] S.Kojima, H.Ohkawa, T.Hirano, S.Maki, H.Niwa, M.Ohashi, S.Inouye, F.I.Tsuji; Tetrahedron Lett., **39**, 5239 **(1998)**.

[9] K.H.Boltze, E.Etschenberg, W.Opitz, S.Raddatz, D.Vollbrecht; Ger.Pat., 2659543 **(1978)**.

[10] E.Etschenberg, W.Opitz, S.Raddatz; Ger.Pat., 2659114 **(1978)**.

[11] E.Etschenberg, W.Opitz, S.Raddatz; Ger.Pat., 22745584 **(1979)**.

[12] E.Etschenberg, H.Jacobi, W.Opitz; Ger.Pat., 2904512 **(1980)**.

[13] M.Kitazawa, R.Higuchi, M.Takahashi, T.wada,

H.Sasabe; J.Phy.Chem., **99**, 14784 **(1995)**.

[14] J.Kashyap, A.B.Chetry, P.J.Das; Synth.Commun., **28**, 4178 **(1998)**.

[15] F.M.Bautista, J.M.Campelo, A.Garcia, D.Luna, J.M.Marinas, A.A.Romero; J.Chem.Soc., Perkin Trans., **2**, 227 **(2002)**.

[16] K.A.Monk, D.Sarapa, R.S.Mohan; Synth.Commun., **30**, 3167 **(2000)**.

[17] M.M.Khodaei, A.R.Khosropour, S.J.H.Jomor; J.Chem.Res.Synop., 638 **(2003)**.

[18] P.S.Rao, R.V.Venkataratnam; Indian J.Chem.Sect, **33(B)**, 984 **(1994)**.

[19] S.Paul, P.Nanda, R.Gupta, A.Loupy; Tetrahedron Lett., **45**, 425 **(2004)**.

[20] V.S.Gerad, F.Notheisz; Heterogeneous Catalysis in Organic Chemistry, Elsevier **(2000)**.

[21] E.Etschenberg, W.Opitz, S.Raddatz; Ger.Pat., 2659114 **(1978)**.

[22] J.H.Clark, D.Macquarrie; J.Chem.Soc.Rev., 303 **(1996)**.

[23] S.V.Shinde, W.N.Jadhav, M.K.Lande, L.S.Gadekar et al.; Catal.Lett., **125**, 57 **(2008)**.

[24] L.S.Gadekar, S.R.Mane, S.S.Katkar, B.R.Arbad, M.K.Lande; Cent.Eur.J.Chem., **7**, 550 **(2009)**.

[25] L.S.Gadekar, S.S.Katkar, S.R.Mane, B.R.Arbad, M.K.Lande; Bull.Korean Chem.Soc., **30**, 2532 **(2009)**.

[26] Yu.Chuanming, Z.Baocheng, S.Weike, Xu. Zhenyuan; Synth.Commun., **36**, 3437 **(2006)**.

[27] M.A.Pasha, V.P.Jayashankara, K.N.Venugopala, G.K.Rao; J.Pharm.Toxi., **2**, 264 **(2007)**.