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# $Zr(HSO_4)_4$ Catalyzed One-Pot Strecker Synthesis of α-Amino Nitriles from Aldehydes and Ketones under Solvent-Free Conditions

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A mild and efficient method has been developed for the preparation of α-amino nitriles from the condensation of aldehydes and ketones with aniline and TMSCN in the presence of a catalytic amount of $Zr(HSO_4)_4$ under solvent-free conditions at room temperature.

**Keywords:** Strecker, α-Amino nitriles, $Zr(HSO_4)_4$, Solid acid

## INTRODUCTION

One-pot multi-component condensation reactions are important and attractive due to the formation of multi-bonds in one pot, high atom economy, mild and simplified conditions and environmentally benign friendliness. Strecker reaction as the first multicomponent reaction (MCR), which was discovered in 1850, represented one of the most important reactions, especially from the life science viewpoint [1]. In this reaction three components including a carbonyl compound (generally an aldehyde), an amine and either alkaline metal cyanide or hydrogen cyanide couple together and produce α-amino nitriles. The Strecker reaction is one of the most straightforward and efficient methods for the synthesis of α-amino nitriles as one of the very useful synthones for the preparation of α-amino acides [2] and heterocyclic compounds such as imidazoles and other biologically important molecules [3]. α-Amino acids have the great biological and economical significance because of their widespread use in chemistry and biology. For example, they are the key precursors for the synthesis of proteins and have several applications as the chiral building blocks in the pharmaceutical industry [4]. Generally, α-amino nitriles are prepared by the nucleophilic addition of cyanide ion to the imines (*in situ* generated from condensation of aldehydes with amines) in the presence of Lewis acid or Lewis base catalysts. Many cyanide sources such as HCN [5], KCN [6], $Bu_3SnCN$ [7], $Et_2AlCN$ [8], $(Et_2O)P(O)CN$ [9] and TMSCN [10] have been used for Strecker reaction. Among the aforementioned reagents, TMSCN is the safer and more efficient cyanide anion source [11].

Many Lewis acid catalysts including $NiCl_2$ [12], $Cu(OTf)_2$ [13], $RuCl_3$ [14], iodine [15], $La(NO_3)_3.6H2O$ or $GdCl_3.6H_2O$ [16], $InCl_3$ [17], $RhI_3.H_2O$ [18] and $Fe(CP)_2PF_6$ [19] have recently been employed for the preparation of α-amino nitriles from aldehydes, amines and trimethylsilylcyanide or tributyltin cyanide. Solid catalysts such as montmorillonite KSF [20], silica-supported heteropoly acids [21], Guanidine

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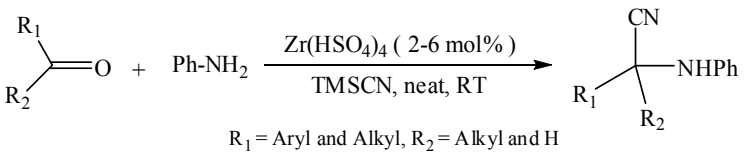



*Scheme 1*

hydrochloride [22] and cellulose sulfuric acid [23] have been used for the synthesis of α-amino nitriles from aldehydes. The synthesis of α-amino nitriles from ketones has been reported under different conditions [24-26].

Recently, the solvent-free reactions have attracted great interest due to the pollution reducing, low cost and convenient and straightforward work-up. In continuation of our efforts to develop new methods in organic synthesis [27-29], we found out that zirconium hydrogen sulfate has many advantages over sulfuric acid alone. This reagent is safe and environmentally benign and presents fewer disposal problems. Lately, the use of $Zr(HSO_4)_4$ as an efficient catalyst for the preparation of acylals, regeneration of carbonyl compounds by cleavage of C=N bonds and acetylation or formylation of primary, secondary and tertiary alcohols has been published [30-33]. Herein, we wish to report an efficient method for one-pot three-component synthesis of α-amino nitriles from various carbonyl compounds, aniline and TMSCN in the presence of catalytic amount of $Zr(HSO_4)_4$ under solvent-free conditions at room temperature (Scheme 1).

## EXPERIMENTAL

### General

All reagents were purchased from Merck and Aldrich and used without further purification. All yields refer to isolated products after purification. $Zr(HSO_4)_4$ was synthesised according to the reported procedure [31]. Products were characterized by spectroscopy data (IR, $^1$H NMR, $^{13}$C NMR spectra) and elemental analyses and melting points. $^1$H NMR (400, 500 MHz) and $^{13}$C NMR (125 MHz) spectra were run in $CDCl_3$ solution relative to TMS (0.00 ppm). IR spectra were recorded on a Shimadzu 435 IR spectrophotometer and performed using KBr pellets. All melting points were taken on a Gallenkamp melting apparatus and were uncorrected.

### General Procedure for the Preparation of α-Amino Nitriles

A mixture of carbonyl compound (1 mmol), aniline or other amines (1 mmol), trimethylsilylcyanide (1.2 mmol) and zirconium hydrogen sulfate (0.02-0.04 mmol for aldehydes and 0.06 mmol for ketones) was stirred at room temperature. The completion of the reaction was monitored with TLC (ethyl acetate/cyclohexane, 1/3), then water (10 ml) was added and the reaction mixture was extracted by ethyl acetate (10 × 3 ml), washed with brine and dried over anhydrous $MgSO_4$. Solvent evaporated under reduced pressure and the product was purified by column chromatography using silica gel to afford the pure product. The spectral (IR, $^1$H NMR and $^{13}$C NMR) data and the elemental analyses of the products are given below. Spectral data were compared with the literature data. Entries 6, 14 and 17 are new compounds.

2-Anilino-2-phenyl acetonitrile (entry 1): IR (KBr): 3337, 2237 cm$^{-1}$; $^1$H NMR ($CDCl_3$, 400 MHz) δ 3.84 (d, 1H, J = 8.0 Hz), 5.25 (d, 1H, J = 8.4 Hz), 6.60 (d, 2H, J = 8.0 Hz), 6.72 (t, 1H, J = 8.0 Hz), 7.04-7.11 (m, 2H), 7.27-7.31 (m, 3H), 7.41-7.43 (m, 2H).

2-Anilino-2-(4-methoxy phenyl) acetonitrile (entry 2): IR (KBr): 3328, 2227 cm$^{-1}$; $^1$H NMR ($CDCl_3$, 400 MHz) δ 3.65 (s, 3H), 3.78 (bs, 1H), 5.15 (d, 1H, J = 6.4 Hz), 6.59 (d, 2H, J = 8.0 Hz), 6.69-6.79 (m, 3H), 7.09 (d, 2H, J = 8.0 Hz), 7.32 (d, 2H, J = 8.0 Hz).

2-Anilino-2-(2-chloro phenyl) acetonitrile (entry 3): IR (KBr): 3338, 2241 cm$^{-1}$; $^1$H NMR ($CDCl_3$, 400 MHz) δ 3.83 (d, 1H, J = 7.6 Hz), 5.54 (d, 1H, J = 8.0 Hz), 6.60 (d, 2H, J = 8.0 Hz), 6.72 (t, 1H, J = 7.6 Hz), 7.09 (t, 2H, J = 8.0 Hz), 7.20-7.22 (m, 2H), 7.29-7.31 (m, 1H), 7.55-7.58 (m, 1H).

2-Anilino-2-(4-methyl phenyl) acetonitrile (entry 4): IR (KBr): 3309, 2243 cm$^{-1}$; $^1$H NMR ($CDCl_3$, 400 MHz) δ 2.21 (s, 3H) 3.83 (bs, 1H), 5.20 (s, 1H), 6.59 (d, 2H, J = 8.0 Hz), 6.71 (t, 1H, J = 7.2 Hz), 7.07-7.11 (m, 4H), 7.29 (d, 2H, J =

7.6 Hz).

2-Anilino-2-(4-chloro phenyl) acetonitrile (entry 5): IR (KBr): 3301, 2246 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 400 MHz) δ 3.84 (bs, 1H), 5.24 (d, 1H, J = 6.0 Hz), 6.56 (d, 2H, J = 7.8 Hz), 6.73 (t, 1H, J = 7.2 Hz), 7.09 (t, 2H, J = 8.0 Hz), 7.25 (d, 2H, J = 8.8 Hz), 7.37 (d, 2H, J = 8.4 Hz).

2-Anilin-2-(2,6-dichloro phenyl) acetonitrile (entry 6): IR (KBr): 3407, 2245 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 500 MHz) δ 4.53 (d, 1H, J = 10.0 Hz), 6.09 (d, 1H, J = 10.4 Hz), 6.66 (d, 2H, J = 8.0 Hz), 6.72 (t, 1H, J = 7.2 Hz), 7.07-7.14 (m, 3H), 7.21 (d, 2H, J = 7.6 Hz); $^{13}C$ NMR ($CDCl_3$, 125 MHz): δ 46.21, 115.32, 116.94, 121.28, 129.99, 130.08, 130.46, 131.61, 135.55, 144.45; Anal. Calcd. for $C_{14}H_{10}N_2Cl_2$: C, 60.67; H, 3.64; N, 10.11; Found: C, 60.10; H, 3.80; N, 10.20.

2-Anilino-2-(3-methoxy phenyl) acetonitrile (entry 7): IR (KBr): 3354, 2225 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 400 MHz) δ 3.65 (s, 3H), 3.86 (bs, 1H), 5.21 (s, 1H), 6.59 (d, 2H, J = 8.0 Hz), 6.72 (t, 1H, J = 7.6 Hz), 6.76 (dd, 1H, J = 2.0, 8.2 Hz), 6.93 (s, 1H), 6.98 (d, 1H, J = 7.6 Hz), 7.09 (t, 2H, J = 8.0 Hz), 7.19 (t, 1H, J = 8.0 Hz).

2-Anilino-2-(4-cyano phenyl) acetonitrile (entry 8): IR (KBr): 3354, 2237 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 500 MHz) δ 4.19 (bs, 1H), 5.58 (s, 1H), 6.80 (d, 2H, J = 7.8 Hz), 6.99 (t, 1H, J = 7.4 Hz), 7.33 (t, 2H, J = 7.6 Hz), 7.81 (s, 4H).

2-Anilino-2-[4-(1-Anilino-1-cyano)-methyl] phenyl acetonitrile (entry 9): IR (KBr): 3330, 2238 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 500 MHz) δ 2.22 (s, 1H), 5.54 (s, 1H), 6.83 (d, 2H, J = 7.7 Hz), 6.98 (t, 1H, J = 7.5 Hz), 7.34 (t, 2H, J = 8.0 Hz), 7.77 (s, 2H).

(E)-2-Anilino-4-phenyl 3-butenenitrile (entry 10): IR (KBr): 3351, 2224 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 400 MHz) δ 3.92 (d, 1H, J = 9.6 Hz), 5.08-5.11 (m, 1H), 6.31 (dd, 1H, J = 4.8, 15.8 Hz ), 6.80 (d, 1H, J = 8.0 Hz), 6.93 (t, 1H, J = 8.0 Hz), 7.08 (d, 1H, J = 16.0 Hz), 7.30-7.47 (m, 7H).

2-Anilino-2-furfuryl acetonitrile (entry 11): IR (KBr): 3375, 2242 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 500 MHz) δ 4.21 (bs, 1H), 5.55 (d, 1H, J = 6.7 Hz), 6.48 (t, 1H, J = 2.6 Hz), 6.64 (d, 1H, J = 3.4 Hz), 6.84 (d, 2H, J = 7.8 Hz), 6.97 (t, 1H, J = 7.4 Hz), 7.33 (t, 2H, J = 7.8 Hz), 7.54 (d, 1H, J = 1.0 Hz).

2-Anilino-2-(5-methyl furfuryl) acetonitrile (entry 12): IR (KBr): 3330, 2241 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 400 MHz) δ 2.14 (s, 3H) 3.95 (d, 1H, J = 8.0 Hz), 5.23 (d, 1H, J = 8.4 Hz), 5.81 (d, 1H, J = 2.0 Hz), 6.27 (d, 1H, J = 2.8 Hz), 6.58 (d, 2H, J = 8.0 Hz), 6.73 (t, 1H, J = 7.2 Hz), 7.09 (t, 2H, J = 8.8 Hz).

2-Anilino-2-phenyl propanenitrile (entry 13): IR (KBr): 3386, 2226 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 400 MHz) δ 1.76 (s, 3H) 4.10 (s, 1H), 6.35 (d, 2H, J = 8.0 Hz), 6.61 (t, 1H, J = 8.0 Hz), 6.93 (t, 2H, J = 8.0 Hz), 7.16-7.23 (m, 3H), 7.44 (d, 2H, J = 7.2 Hz).

2-Anilino-2-(3-methoxy phenyl) propanenitrile (entry 14): IR (KBr): 3384, 2230 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 500 MHz) δ 1.99 (s, 3H) 3.85 (s, 3H), 4.30 (bs, 1H), 6.61 (d, 2H, J = 8.0 Hz), 6.86 (t, 1H, J = 7.3 Hz), 6.93 (dd, 1H, J = 2.6, 8.0 Hz), 7.17 (t, 2H, J = 8.0 Hz), 7.21 (t, 1H, J = 2.0 Hz), 7.27 (d, 1H, J = 7.8 Hz), 7.37 (t, 1H, J = 7.9 Hz); $^{13}C$ NMR ($CDCl_3$, 125 MHz): δ 33.74, 55.77, 57.53, 111.16, 114.29, 116.21, 117.55, 120.47, 121.05, 129.44, 130.77, 142.08, 143.90, 160.73; Anal. Calcd. for $C_{16}H_{13}N_2O$: C, 77.09; H, 5.26; N, 11.24; Found: C, 77.30; H, 5.40; N, 10.90.

1-Anilino-1-cycloheptane carbonitrile (entry 15): IR (KBr): 3365, 2238 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 500 MHz) δ 1.65-1.70 (m, 2H), 1.72-1.81 (m, 6H), 2.00-2.05 (m, 2H), 2.33-2.38 (m, 2H), 3.69 (bs, 1H), 6.92-6.95 (m, 3H), 7.29 (t, 2H, J = 8.2 Hz).

1-Anilino-1-cyclopentane carbonitrile (entry 16): IR (KBr): 3368, 2235 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 500 MHz) δ 1.89-1.97 (m, 4H), 2.16-2.21 (m, 2H), 2.41-2.46 (m, 2H), 3.90 (bs, 1H), 6.87 (d, 2H, J = 7.8 Hz), 6.92 (t, 1H, J = 7.4 Hz), 7.28-7.31 (m, 3H).

5-Methoxy-1-anilino-1,2,3,4-tetrahydronaphthalene-1-carbonitrile (entry 17): IR (KBr): 3395, 2227 $cm^{-1}$; $^1H$ NMR ($CDCl_3$, 500 MHz) δ 1.59 (bs, 1H), 1.91-1.93 (m, 2H), 2.19-2.21 (m, 1H), 2.66-2.67 (m, 1H), 2.74-2.77 (m, 1H), 2.86-2.90 (m, 1H), 6.91-6.97 (m, 4H), 7.29 (t, 2H, J = 7.7 Hz), 7.34 (t, 1H, J = 8.0 Hz), 7.43 (d, 1H, J = 7.8 Hz); $^{13}C$ NMR ($CDCl_3$, 125 MHz): δ17.34, 22.87, 31.75, 55.47, 55.98, 110.62, 117.20, 120.70, 120.89, 122.38, 126.51, 127.98, 129.74, 135.85, 143.91, 157.64; Anal. Calcd. for $C_{18}H_{18}N_2O$: C, 77.67; H, 6.52; N, 10.06; Found: C, 77.50; H, 6.80; N, 9.80.

## RESULTS AND DISSCUTION

In order to obtain the best reaction conditions, the reaction of benzaldehyde (1 mmol), aniline (1 mmol) and TMSCN (1.2 mmol) was examined in the presence of 4 mol% of $Zr(HSO_4)_4$ as catalyst in acetonitrile at room temperature. When the reaction mixture was stirred at room temperature for 6 h, some

**Table 1.** Effect of Different Amounts of the Catalyst on the Synthesis of 2-Anilino-2-phenyl Acetonitrile[a]

| Entry | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Mol% catalyst | 1 | 2 | 4 | 10 | 15 |
| Time (min)[b] | 10 | 5 | 5 | 10 | 30[c] |

[a]Bezaldehyde (1 mmol), aniline (1 mmol), TMSCN (1.2 mmol) and $Zr(HSO_4)_4$ (1-15 mol%) under solvent-free conditions at room temprature. [b]The time of completion of the reaction based on TLC. [c]The reaction did not complete and undesired product was observed.

undesired products were observed. Therefore, we tried to trigger this reaction under solvent-free conditions and found that the reaction took place in 5 min. Optimized amounts of the catalyst were provided using several molar amounts of $Zr(HSO_4)_4$ under solvent-free conditions (Table 1). As it is shown in Table 1, no improvement was observed for the reaction rate by increasing the amount of the catalyst from 2 to 4 mol% (entries 2-3, Table 1). Both the lesser (1 mol %) and the higher (10 mol%) amounts of the catalyst worked with longer reaction times (entries 1 and 4, Table 1). The reaction did not complete even after 30 min and using 15 mol% of the catalyst and undesired products were observed (entry 5, Table 1).

In order to show the catalytic activity of $Zr(HSO_4)_4$ in comparison to the other catalysts, we have compared the results of the synthesis of 2-anilino-2-phenyl acetonitrile from benzaldehyde, aniline and TMSCN at room temperature. The results are presented in (Table 2).

We employed 2-4 mol% of the catalyst for one-pot synthesis of α-amino nitriles from aldehydes under solvent-free conditions at room temperature (entries 1-13, Table 3). Aromatic, aliphatic and heterocyclic aldehydes under the optimum conditions coupled with aniline and TMSCN to produce the corresponding α-amino nitriles in high to excellent yields. The mildness of the reaction conditions permits furfural, 5-methyl furfural and cinnamaldehyde to undergo reactions successfully to produce α-amino nitriles in high yields and short reaction times without formation of any polymerization products (entries 10-12, Table 3). The reaction times for 2-chloro benzaldehyde and 2,6-dichloro benzaldehyde were longer than the others (entries 3 and 6, Table 3), which may be due to the steric hindrance effect. It should be noted that electron-withdrawing substituents such as -CN, or -Cl, decreased the Strecker reaction yields (entry 8, Table 3).

To the best of our knowledge, only few studies on Strecker

**Table 2.** Effect of Different Catalysts for Synthesis of α-Amino Nitriles from Benzaldehyde (1 mmol), Aniline (1 mmol) and TMSCN at Room Temperature and Different Solvents or Solvent-Free Conditions

| Entry | Catalyst (mol%) | TMSCN (mmol) | Solvent | Time | Yield (%) | Ref. |
|---|---|---|---|---|---|---|
| 1 | $Cu(OTf)_2$ (2) | TMSCN (1) | $CH_3CN$ | 6 h | 89 | [13] |
| 2 | GuHCl (3) | TMSCN (1.1) | $CH_3OH$ | 1 h | 94 | [22] |
| 3 | $PW/SiO_2$ (7) | TMSCN (1.5) | $CH_3CN$ | 5 min | 98 | [21] |
| 4 | $PW/SiO_2$ (7) | KCN (1.5) | $CH_3CN$ | 30 min | 95 | [21] |
| 5 | Cellulose sulfuric acid (0.05 g) | TMSCN (1.2) | $CH_3CN$ | 45 min | 97 | [23] |
| 6 | $La(NO_3).6H_2O$ (10) | TMSCN (1.2) | $CH_3CN$ | 1 h | 96 | [16] |
| 7 | $GdCl_3.6H_2O$ (10) | TMSCN (1.2) | $CH_3CN$ | 1 h | 94 | [16] |
| 8 | $InCl_3$ (30) | KCN (1.5) | THF | 6 h | 75 | [17] |
| 9 | $RhI_3.H_2O$ (2) | TMSCN (1.2) | $CH_3CN$ | 10 min | 97 | [18] |
| 10 | $Fe(CP)_2PF_6$ (5) | TMSCN (1.3) | - | 20 min | 94 | [19] |
| 11 | Catalyst-free | TMSCN (1.03) | $CH_3CN$ | 17.5 h | 92 | [34] |
| 12 | $Zr(HSO_4)_4$ (2) | TMSCN (1.2) | - | 5 min | 92 | - |

**Table 3.** Strecker Synthesis of α-Amino Nitriles from Various Aldehydes and Ketones Catalyzed by $Zr(HSO_4)_4$ under Solvent-Free Conditions at Room Temperature

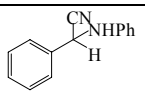
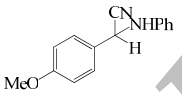
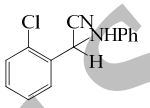
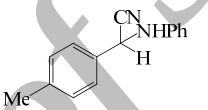
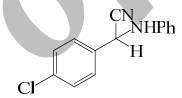
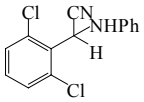
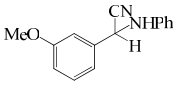
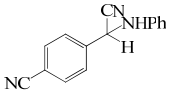
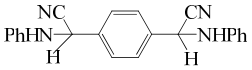
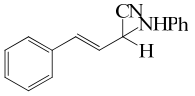
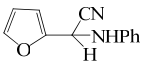
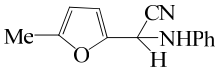
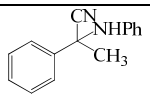
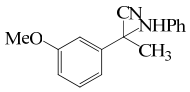
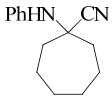
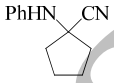
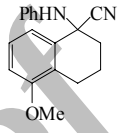
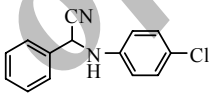
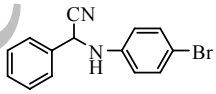
| Entry | Substrate | Product | Time (min) | Yield (%)[a,b] | M.P. |
|---|---|---|---|---|---|
| 1 | Benzaldehyde |  | 5 | 92 | 82-84 |
| 2 | 4-Methoxy benzaldehyde |  | 10 | 85 | 94-97 |
| 3 | 2-Chloro benzaldehyde |  | 30 | 80 | 63-66 |
| 4 | 4-Methyl benaldehyde |  | 10[b] | 90 | 72-74 |
| 5 | 4-Chloro benzaldehyde |  | 10 | 85 | 104-106 |
| 6 | 2,6-Dichloro benzaldehyde |  | 60 | 86 | 73-76 |
| 7 | 3-Methoxy benzaldehyde |  | 15 | 91 | 56-58 |
| 8 | 4-Cyano benzaldehyde |  | 15[c] | 70 | 118-121 |
| 9 | Terephthaldialdehyde |  | 10[c] | 83 | 157-160 |
| 10 | Cinnamaldehyde |  | 15 | 85 | 104-106 |
| 11 | Fufural |  | 5 | 90 | 66-69 |
| 12 | 5-Methyl furfural |  | 5 | 83 | 108-110 |

**Table 3.** Continued

| | | | | | |
|---|---|---|---|---|---|
| 13 | Acetophenone |  | 10 | 80 | 133-136 |
| 14 | 3'-Methoxy acetophenone |  | 15 | 75 | 120-123 |
| 15 | Cycloheptanone |  | 20 | 90 | 83-86 |
| 16 | Cyclopentanone |  | 20 | 93 | 51-54 |
| 17 | 5-Methoxy-1-tetralone |  | 20 | 84 | 99-102 |
| 18 | Benzaldehyde[d] |  | 10 | 85 | 69-72 |
| 19 | Benzaldehyde[f] |  | 10 | 88 | 94-96 |

[a]Isolated yields. [b]The products were characterized from their spectral (IR, $^1$H NMR) and compared with authentic samples. [c]4 mol% catalyst. [d]4-chloro aniline was used. [f]4-Bromo aniline was used.

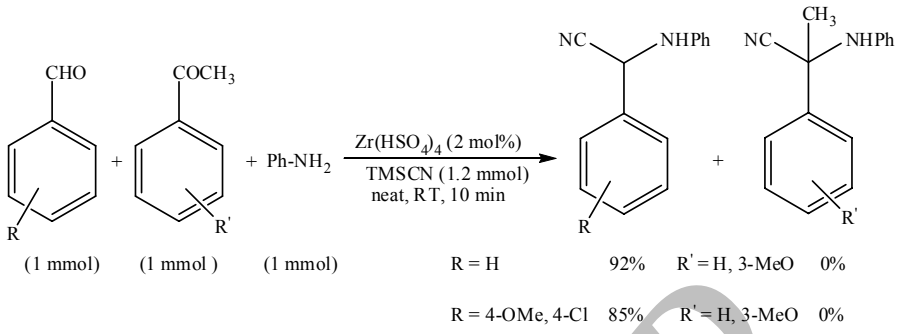
reaction with ketones have been reported in the literatures [19,24-26]. In this study, we examined the condensation of ketones with aniline and TMSCN in the presence of 6 mol% of $Zr(HSO_4)_4$ under solvent-free conditions at room temperature (entries 13-17, Table 3). The reactions proceeded in longer times in comparison to aldehydes, to produce the corresponding α-amino nitriles from ketones.

Furthermore, the reactions of benzaldehyde with other aromatic amines such as 4-chloro aniline and 4-bromo aniline in the presence of TMSCN as cyanating agent and $Zr(HSO_4)_4$ as catalyst were investigated. As it is displayed in Table 3 (entries 18-19), the corresponding α-amino nitriles were produced in high yields and short reaction times. Also, the reactions of benzaldehyde with TMSCN and aliphatic amines such as benzyl amine, homoveratryl amine and butyl amine in the presence of $Zr(HSO_4)_4$ as catalyst were examined under solvent-free conditions and room temperature. The yields of the corresponding α-amino nitriles after 3 h were low and the undesired products were observed. This may be due to the higher basicity of the aliphatic amines.

To measure the selectivity of this method, we started some competitive reactions for the preparation of α-amino nitriles from aldehydes in the presence of ketones using zirconium hydrogen sulfate as catalyst under solvent-free conditions. As shown in Scheme 2, the aldehydes in the presence of ketones were selectively converted to the corresponding α-amino nitriles and the starting ketones were recovered intact.

## CONCLUSIONS

In conclusion, we have developed a facile, convenient and solvent-free method for the one-pot Strecker synthesis of α-




*Scheme 2*

amino nitriles from the coupling of various aldehydes and ketones with aniline and trimethylsilyl cyanide using zirconium hydrogen sulfate as an efficient catalyst. Making use of inexpensive and relatively non-toxic catalyst, high catalytic efficiency, short reaction times, straightforward work-up and environmentally benign procedure are among the advantages of the method in question. Moreover, this method is highly selective for the preparation of α-amino nitriles from aldehydes in the presence of ketones. Therefore, this procedure is general and can be used for coupling of various aliphatic, aromatic, benzylic and cyclic aldehydes and ketones.

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