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# Titanium(IV)chloride-Triethylsilane Mediated Conversion of ω-Nitrostyrenes to Phenylacetohydroximoyl chlorides[#]

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*A novel methodology for hitherto unknown phenylacetohydroximoyl chlorides from ω-nitrostyrenes by reaction with $TiCl_4$-$Et_3SiH$ is reported.*

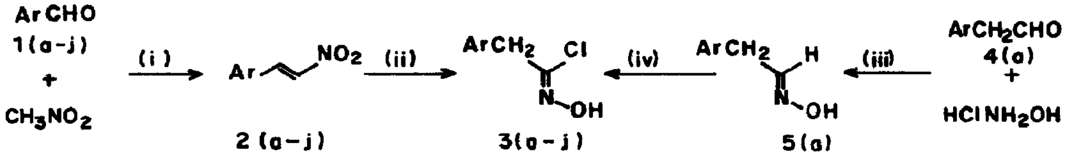
The utility of hydroximoyl chlorides in organic synthesis[1] has considerable interest since they are stable and frequently used precursors for the generation of important 1,3-dipoles *viz*, nitrile oxides. Besides the synthesis of polyfunctionalised complex molecules[2] by the use of cycloaddition of nitrile oxides with dipolorophiles, ingenious reactions on hydroximoyl chlorides have recently been devised for the carbon-carbon bond formation[3] *via* nitrile oxides, thus widening the scope of their synthetic utility.

Although the use of nitrile oxides has been investigated extensively,[4] the synthesis of their precursors *viz*, hydroximoyl chlorides has received only limited attention. Hence the development of effective method for the synthesis of novel hydroximoyl chlorides has still remained a task far from perfection.

Hydroximoyl chlorides are generally prepared from aldoximes using a variety of chlorinating agents.[5] These methods led to an extensive study on benzohydroximoyl chlorides as aromatic nitrile oxide precursors. To the best of our knowledge there is no report for the preparation of phenylacetohydroximoyl chlorides as well as C-3 benzyl substituted isoxazolines and isoxazoles.

During the course of our study on the synthesis of hydroximoyl chlorides from conjugated nitro olefins,[6] we observed that a combination of equimolar proportions of $TiCl_4$ and $Et_3SiH$ was particularly selective for the synthesis of phenylacetohydroximoyl chlorides from their respective ω-nitrostyrenes and offers a convenient method for the synthesis of title compounds in one pot at room temperature (**Scheme 1**).

SCHEME-1



(i) aq. NaOH, MeOH, 0°C, ½ hr. and HCl (ii) $TiCl_4$ - $Et_3SiH$, $CH_2Cl_2$, rt, 1hr
(iii) NaOAc, $H_2O$ - EtOH, rt, 8hr (iv) NCS, DMF, rt, 2hr

Thus treatment of ω-nitrostyrene (**1a**) (0.01 mol) and $Et_3SiH$ (0.01 mol) in dry methylene chloride with $TiCl_4$ (0.012 mol 1M solution in methylene chloride) at room temperature for one hour furnished phenylacetohydroximoyl chloride (**3a**) in good yield (**Table 1**). The product **3a** was characterized by IR, NMR, elemental analysis and confirmed by synthesizing **3a** by an alternate route from phenylacetaldehyde (**4a**) as outlined in the Scheme-1 (compared by IR, $^1H$ NMR, m.p. and undepressed mixed m.p.).

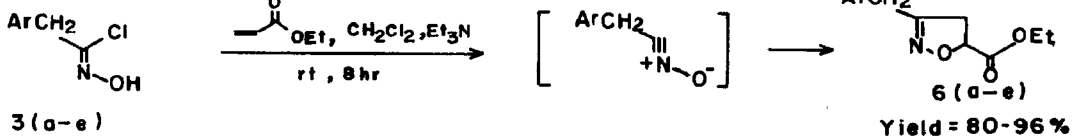
**Table 1: Synthesis of phenylacetohydroximoyl chlorides (3a-j)**

| Compd.No | Ar | m.p(°c) | Yield(%) | Compd.No | Ar | m.p(°c) | Yield(%) |
|---|---|---|---|---|---|---|---|
| **3a** | $C_6H_5$ | 87 | 76 | **3f** | 4-$FC_6H_4$ | 90 | 69 |
| **3b** | 4-$NO_2C_6H_4$ | 108 | 63 | **3g** | 4-$ClC_6H_4$ | 83 | 65 |
| **3c** | 3-$BrC_6H_4$ | 36 | 80 | **3h**** | 4-$EtOC_6H_4$ | semisoild | 52 |
| **3d** | 2-$ClC_6H_4$ | 107 | 70 | **3i** | 2-$NO_2C_6H_4$ | 123 | 84 |
| **3e** | 3,4-$Cl_2C_6H_3$ | 66 | 65 | **3j** | 4-$MeC_6H_4$ | 82 | 80 |

** Reaction temperature was 0°C

The structures assigned to hydroximoyl chlorides were unequivocally proved by synthesizing ethyl 3-benzyl-2-isoxazoline-5-carboxylates (**6a-e**) by cycloaddition of nitrile oxides generated from (**3a-e**) with ethyl acrylate in excellent yields (**Scheme 2**).

SCHEME-2



The conventional route for the preparation of phenylacetohydroximoyl chlorides requires the expensive phenylacetaldehydes which are not readily available. Since benzaldehydes and nitromethane are easily available and less expensive, our methodology described herein, offers a more general and superior route for the synthesis of phenylacetohydroximoyl chlorides.

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