Supporting Information

Direct synthesis of 2-methylpyridines via I$_2$-triggered [3 + 2 + 1] annulation of aryl methyl ketoxime acetates with triethylamine as the carbon source

Qinghe Gao,*a Huijuan Yan,*a Manman Wu,*a Jiajia Sun,*a Xiqing Yan,*a and Anxin Wub

*aSchool of Pharmacy, Xinxiang Medical University, Xinxiang, Henan 453003, P. R. China.
bKey Laboratory of Pesticide & Chemical Biology, Ministry of Education, College of Chemistry, Central China Normal University, Wuhan 430079, P. R. China.

E-mail: gao_qinghe@xxmu.edu.cn

Table of Contents

<table>
<thead>
<tr>
<th>Table of Contents</th>
<th>page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The cross-coupling reaction and the spectrogram of HRMS</td>
<td>S2</td>
</tr>
<tr>
<td>2. The $^{13}$C-labeling and D-labeling experiments and the spectrogram</td>
<td>S2-S4</td>
</tr>
<tr>
<td>3. The HSQC and HMBC of 3d</td>
<td>S5</td>
</tr>
<tr>
<td>4. $^1$H and $^{13}$C NMR spectra of compounds 3</td>
<td>S6-S25</td>
</tr>
</tbody>
</table>
1. The cross-coupling reaction and the spectrogram of HRMS

In order to further confirm our proposed mechanism, we investigated the cross-coupling reaction between two representative substrates 4-methylacetophenone oxime acetate (1a) and acetophenone oxime acetate (1f) under standard conditions. Fortunately, all the products were successfully identified by HRMS analysis of the crude reaction extract.

2. The $^{13}$C-labeling and D-labeling experiments and the spectrogram

We further experimented to develop a better understanding of the reaction mechanism by performing $^{13}$C-labeling and D-labeling experiments under the optimized conditions using acetophenone-β,β,β-$d_3$ oxime acetate and acetophenone-β-$^{13}$C oxime acetate, respectively, as substrates. The corresponding desired products 3f' and 3f-$d_2$ were obtained in 82% and 79% yields, respectively (Scheme 4a and 4b). These experimental results strongly suggested that methyl ketone $O$-acetylloximes provided four carbons to form the pyridine ring. Then, the speculation that the $\alpha$-C of TEA was integrated into the final pyridines has been demonstrated when TEA-$d_{15}$ was used in this reaction system (Scheme 4c). Both of this deuterated experimental evidences are in agreement with the observation of internal D/H exchange in the 2-methylpyridines.
NOAc + N(CD₂CD₃)₃ → standard conditions → D/H = 0.5:0.5

3a-d₂ 70%
3. The HSQC and HMBC of 3d
4. $^1$H and $^{13}$C NMR spectra of compounds 3