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SHORT COMMUNICATIONS

New Microwave-Assisted Reaction of 3-Trimethylsilylpropynal with 2-Aminopyridine

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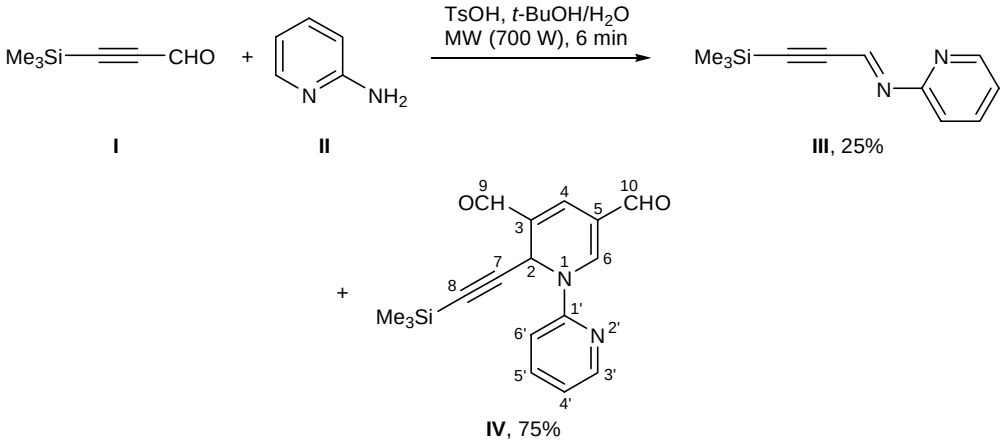
We previously showed that the triple bond in heteroelement-containing propynals $R_3EC{\equiv}CHO$ (E = Si, Ge) in the absence of a catalyst is inactive toward N-nucleophiles [1]. Primary amines add to silicon- and germanium-containing propynals and their carbon analog, 3-*tert*-butylpropynal, chemoselectively at the aldehyde group to give the corresponding Schiff bases in almost quantitative yield [2]. We recently proposed a new highly efficient approach to heteroelement-containing propynals via microwave-assisted solid-phase reaction which ensured direct transformation of acetylenic alcohols into yne imines [3].

Surprisingly, while studying the acid-catalyzed reaction of 3-trimethylsilyl-2-propynal (**I**) with 2-aminopyridine (**II**) under microwave irradiation, apart from the expected Schiff base **III**, we isolated previously unknown 1-(2-pyridyl)-2-trimethylsilylethynyl-1,2-dihydropyridine-3,5-dicarbaldehyde (**IV**). According to the ^{1}H NMR data, the yield of compound **IV** in the reaction of propynal **I** with an equimolar amount of 2-aminopyridine in aqueous *tert*-butyl alcohol in the presence of *p*-toluenesulfonic acid (5 mol %) under microwave irradiation (reaction time 6 min) was 75%. 1,2-Dihydropyridine **IV** was isolated by chromatography on aluminum oxide. Its structure was proved by the ^{1}H and ^{13}C NMR, IR, and mass spectra and elemental analysis. Signals in the NMR spectra were assigned using COSY, HSQC, and HMBC techniques.

Presumably, compound **IV** is formed as a result of a cascade process including nucleophilic addition of 2-aminopyridine at the β-carbon atom at the triple bond to give 3-(2-pyridylamino)-3-trimethylsilyl-2-propenal which then acts as C-nucleophile toward the second molecule of propynal **I** (Michael addition). The subsequent intermolecular cyclocondensation of intermediate aminodienedial at the carbonyl group of the third molecule of **I** leads to final product **IV**. The presence of a trimethylsilylethynyl group in position *2* of the pyridine ring in **IV** suggests that elimination of the trimethylsilyl group occurs from some intermediate β-aminoenal rather than from initial propynal **I**. Dihydropyridine **IV** is also formed in a comparable yield



I **II** **III**, 25%

IV, 75%

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by the reaction of equimolar amounts of propynal **I** and 2-aminopyridine in acetonitrile in the presence of hydrochloric acid (5 mol %) without microwave irradiation; however, in this case, the process takes 7 days. Taking into account that in the absence of a catalyst compounds **I** and **II** give rise to only Schiff base **III**, the role of acid catalyst in this reaction is obvious.

Polyfunctional dihydropyridines are promising readily modifiable building blocks for organic synthesis. However, the synthesis of functionally substituted 1,2-dihydropyridines is often difficult; they are usually prepared by reduction [4–6] or functionalization [7] of pyridine derivatives.

1-(2-Pyridyl)-2-trimethylsilylethynyl-1,2-dihydropyridine-3,5-dicarbaldehyde (IV). *a*. A glass ampule was charged with 0.0941 g (1 mmol) of amine **II**, 0.0086 g (0.05 mmol) of *p*-toluenesulfonic acid, 0.38 ml of *tert*-butyl alcohol, and 0.07 ml of water (the overall volume of the reaction mixture should not exceed 1/10–1/12 of the ampule capacity). Aldehyde **I**, 0.1283 g (1 mmol), was added to the resulting homogeneous solution, and a colorless solid separated. The ampule was sealed and irradiated in a microwave furnace (LG MS-1904H, 700 W) over a period of 6 min in 1-min pulses. It was then cooled to room temperature, the solvent was removed under reduced pressure, and the solid residue was analyzed by ^{1}H NMR spectroscopy (the yield of dihydropyridine **IV** was 75% calculated on the initial propynal **I**). By chromatography on aluminum oxide (eluent diethyl ether–tetrahydrofuran, 10:1, by volume) we isolated 50 mg of compound **IV** as a yellow powder with mp 158–160°C. IR spectrum, ν, cm^{-1}: 1730 (C=O), 2160 (C≡C). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm: 0.05 s (9H, Me_3Si), 5.99 s (1H, 2-H), 7.20 d.d (1H, 4'-H, $^3J_{3',4'}$ = 4.8 Hz, $^3J_{4',5'}$ = 7.4 Hz), 7.46 d (1H, 6'-H, $^3J_{5',6'}$ = 7.4 Hz), 7.53 s (1H, 4-H), 7.82 t.d (1H, 5'-H, $^4J_{3',5'}$ = 2.0 Hz), 8.43 d.d (1H, 3'-H), 8.71 s (1H, 6-H), 9.47 s (1H, 10-H), 9.53 s (1H, 9-H). ^{13}C NMR spectrum ($CDCl_3$), δ, ppm: –0.59 (Me_3Si), 45.79 (C^2), 91.42 (C^7), 99.65 (C^8), 111.00 ($C^{6'}$), 114.88 (C^5), 120.97 ($C^{4'}$), 125.49 (C^3), 135.82 (C^4), 138.94 ($C^{5'}$), 147.34 (C^6), 148.49 ($C^{3'}$), 151.18 ($C^{1'}$), 186.23 (C^{10}), 188.49 (C^9). Mass spectrum, *m*/*z* (I_{rel}, %): 310 (5) $[M]^+$, 281 (100) [*M* – CHO], 232 (13) [*M* – C_5H_4N], 78 (55) [C_5H_4N], 51 (12) [C_5H_4N – HCN]. Found, %: C 65.10; H 6.17; N 8.73. $C_{17}H_{18}N_2O_2Si$. Calculated, %: C 65.78; H 5.84; N 9.02.

b. A solution of 0.1633 g (1.29 mmol) of aldehyde **I**, 0.1214 g (1.29 mmol) of amine **II**, and 0.3 ml of 0.8% hydrochloric acid (5 mol %) in 1 ml of acetonitrile was kept for 7 days at 25°C with intermittent shaking. The solvent was removed under reduced pressure, and the solid residue was analyzed by ^{1}H NMR spectroscopy. Yield of dihydropyridine **IV** 75%.

The IR spectrum was recorded on a Specord 75-IR spectrometer. The ^{1}H and ^{13}C NMR were recorded on a Bruker DPX-400 instrunent using $CDCl_3$ as solvent and HMDS as internal reference.

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