

# Reactions of 1,3-dibromopropyne with 1-aryl-2,2-dimethylhydrazines as a new method for the synthesis of substituted 1,3,4-oxadiazinium bromides

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Reactions of 1-aryl-2,2-dimethylhydrazines with 1,3-dibromopropyne in MeOH or MeCN at 20–50 °C yield 2-aryl-6-bromomethylidene-4,4-dimethyl-5*H*-1,3,4-oxadiazinium bromides.

**Key words:** 1-aryl-2,2-dimethylhydrazines, 1,3-dibromopropyne, substituted 1,3,4-oxadiazinium bromides, amide-imide tautomerism, alkylation.

Among a variety of transformations of 1,1-dimethylhydrazine and its derivatives, their quaternization with alkynyl halides is studied insufficiently to date.

The known reactions of 1,1-dimethylhydrazine with propargyl bromide<sup>1</sup> and propargyl chloride<sup>2</sup> yield 1,1-dimethyl-1-(prop-2-ynyl)hydrazinium bromide and chloride, respectively. Arylethynyl bromides react with 1,1-dimethylhydrazine to give 1-(2-aryl-1-bromovinyl)-1,1-dimethylhydrazinium bromides.<sup>3</sup> The reactions of 1,1-dimethylhydrazones with propargyl bromide and 1,3-dibromopropyne afford 1,1-dimethyl-1-(prop-2-ynyl)hydrazone and 1-(3-bromoprop-2-ynyl)-1,1-dimethylhydrazonium bromides, respectively, in 30–72% yield.<sup>4</sup>

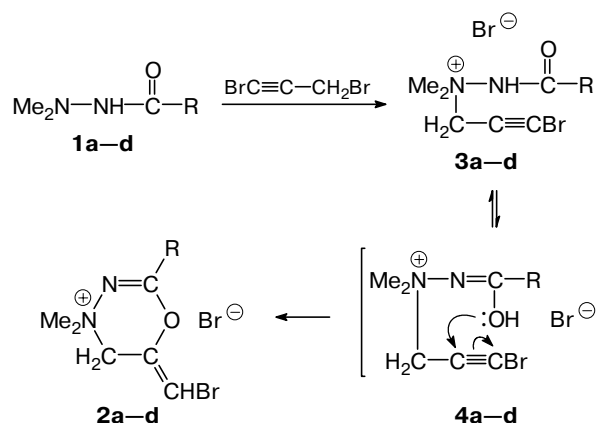
## Results and Discussion

We found that the reactions of 1-benzoyl-, 1-(4-bromobenzoyl)-, and 1-(2-chlorobenzoyl)-2,2-dimethylhydrazines and 2,2-dimethyl-1-(4-toluy)hydrazine (**1a–d**) with 1,3-dibromopropyne give 2-aryl-6-bromomethylidene-4,4-dimethyl-5*H*-1,3,4-oxadiazinium bromides **2a–d**. Initially, 1-aryl-2,2-dimethylhydrazines **1a–d** are alkylated with 1,3-dibromopropyne at the tertiary N atom to form 1-aryl-2-(3-bromoprop-2-ynyl)-2,2-dimethylhydrazinium bromides (**3a–d**) (Scheme 1).

The formation of isomeric compounds, namely, 1-aryl-2-(3-bromoprop-1-ynyl)-2,2-dimethylhydrazinium bromides, could be expected. However, when studying the reactions of 1,1-dimethylhydrazones with 1,3-dibromopropyne and propargyl bromide,<sup>4</sup> we have demonstrated that the tertiary N atom is alkylated exclusively with the CH<sub>2</sub>Br fragment.

As a result of amide-imide tautomerism,<sup>5,6</sup> bromides **3a–d** in MeOH or MeCN pass into intermediates **4a–d**, which undergo intramolecular cyclization to give 1,3,4-oxadiazinium bromides **2a–d**. The structures of

Scheme 1



R = Ph (**a**), 4-BrC<sub>6</sub>H<sub>4</sub> (**b**), 2-ClC<sub>6</sub>H<sub>4</sub> (**c**), 4-MeC<sub>6</sub>H<sub>4</sub> (**d**)

the latter were proved by elemental analysis and IR and <sup>1</sup>H, <sup>13</sup>C, and <sup>15</sup>N NMR data.

In the reaction of 1-(4-bromobenzoyl)-2,2-dimethylhydrazine (**1b**) with 1,3-dibromopropyne, we isolated not only 1,3,4-oxadiazinium bromide **2b**, but also 1-(4-bromobenzoyl)-2-(3-bromoprop-2-ynyl)-2,2-dimethylhydrazinium bromide (**3b**), which confirms the suggested reaction mechanism (see Scheme 1).

Hence, we proposed a new method for the synthesis of 2-aryl-6-bromomethylidene-4,4-dimethyl-5*H*-1,3,4-oxadiazinium bromides by the reactions of 1-aryl-2,2-dimethylhydrazine with 1,3-dibromopropyne.

## Experimental

IR spectra were recorded on a Specord IR-75 instrument (KBr pellets). <sup>1</sup>H, <sup>13</sup>C, and <sup>15</sup>N NMR spectra were recorded on a Bruker DPX-400 spectrometer (400.13, 100.62, and

40.54 MHz, respectively) in DMSO- $d_6$  at 20 °C with HMDS as the internal standard.

**1-Benzoyl-2,2-dimethylhydrazine (1a)** was synthesized as described earlier<sup>5</sup> from 1,1-dimethylhydrazine (3 g, 0.05 mol) and benzoyl chloride (7.03 g, 0.05 mol) in benzene at 20 °C. The yield of compound **1a** was 1.7 g (21%), white crystals, m.p. 106–107 °C (from CCl<sub>4</sub>). Found (%): C, 65.63; H, 7.31; N, 16.95. C<sub>9</sub>H<sub>12</sub>N<sub>2</sub>O. Calculated (%): C, 65.83; H, 7.37; N, 17.06. IR,  $\nu/cm^{-1}$ : 3190 (NH); 1640 (C=O).

**1-(4-Bromobenzoyl)-2,2-dimethylhydrazine (1b)** was obtained from 4-bromobenzoyl chloride (4.4 g, 0.02 mol) and 1,1-dimethylhydrazine (2.4 g, 0.04 mol) in THF at 40 °C. The yield of compound **1b** was 3.7 g (77%), white crystals, m.p. 148–150 °C (from MeCN). Found (%): C, 44.12; H, 4.82; Br, 32.74; N, 11.23. C<sub>9</sub>H<sub>11</sub>BrN<sub>2</sub>O. Calculated (%): C, 44.47; H, 4.56; Br, 32.87; N, 11.52. IR,  $\nu/cm^{-1}$ : 3200 (NH); 1640 (C=O).

**1-(2-Chlorobenzoyl)-2,2-dimethylhydrazine (1c)** was synthesized from 1,1-dimethylhydrazine (7.2 g, 0.12 mol) and 2-chlorobenzoyl chloride (10.5 g, 0.06 mol) in THF at 40 °C. The yield of compound **1c** was 6.9 g (58%), white crystals, m.p. 150–152 °C (from CCl<sub>4</sub>). Found (%): C, 54.30; H, 6.01; Cl, 18.20; N, 14.52. C<sub>9</sub>H<sub>11</sub>ClN<sub>2</sub>O. Calculated (%): C, 54.42; H, 5.58; Cl, 17.85; N, 14.10. IR,  $\nu/cm^{-1}$ : 3180 (NH); 1640 (C=O).

**2,2-Dimethyl-1-(4-tolyl)hydrazine (1d)** was obtained from 4-tolyl chloride (5.0 g, 32 mmol) and 1,1-dimethylhydrazine (3.9 g, 65 mmol) in THF at 40 °C. The yield of compound **1d** was 3.5 g (61%), white crystals, m.p. 103–105 °C (from MeCN). Found (%): C, 67.32; H, 8.25; N, 15.98. C<sub>10</sub>H<sub>14</sub>N<sub>2</sub>O. Calculated (%): C, 67.41; H, 7.86; N, 15.73. IR,  $\nu/cm^{-1}$ : 3222 (NH); 1646 (C=O).

**6-Bromomethylidene-4,4-dimethyl-2-phenyl-5H-1,3,4-oxadiazinium bromide (2a).** A solution of 1,3-dibromopropyne (1.8 g, 9 mmol) in 20 mL of anhydrous MeOH was slowly added with stirring to a solution of 1-benzoyl-2,2-dimethylhydrazine (**1a**) (1.5 g, 9 mmol) in 30 mL of anhydrous MeOH. The reaction mixture was heated to 50 °C, stirred at this temperature for 5 h, and then cooled to 0 °C. The precipitate that formed was filtered off, washed with cold ether, and dried *in vacuo*. The yield of 1,3,4-oxadiazinium bromide **2a** was 3.0 g (91%), white crystals, m.p. 148–149 °C. Found (%): C, 39.64; H, 3.85; Br, 44.45; N, 7.91. C<sub>12</sub>H<sub>14</sub>Br<sub>2</sub>N<sub>2</sub>O. Calculated (%): C, 39.78; H, 3.87; Br, 44.20; N, 7.93. IR,  $\nu/cm^{-1}$ : 2950 (CH<sub>2</sub>); 1610 (C=N); 1570 (C=C); 690 (C–Br). <sup>1</sup>H NMR,  $\delta$ : 3.53 (d, 6 H, Me); 4.91 (s, 2 H, CH<sub>2</sub>); 6.80 (s, 1 H, =CHBr); 7.61–7.98 (m, 5 H, Ph). <sup>13</sup>C NMR,  $\delta$ : 55.7 (Me); 57.3 (CH<sub>2</sub>); 94.8 (C=CHBr); 124.5–133.7 (Ph); 139.1 (CHBr); 157.2 (C=N).

**6-Bromomethylidene-2-(4-bromophenyl)-4,4-dimethyl-5H-1,3,4-oxadiazinium bromide (2b) and 1-(4-bromobenzoyl)-2-(3-bromoprop-2-ynyl)-2,2-dimethylhydrazinium bromide (3b).** A solution of 1,3-dibromopropyne (1.78 g, 9 mmol) in 10 mL of MeCN was added with stirring to a solution of 1-(4-bromobenzoyl)-2,2-dimethylhydrazine (**1b**) (2.37 g, 9 mmol) in 40 mL of MeCN. The reaction mixture was stirred at 20 °C for 20 h and then cooled to 0 °C. The precipitate that formed was filtered off, washed with cold MeCN, and dried *in vacuo*. The yield of compound **2b** was 1.2 g (28%), white crystals, m.p. 154–155 °C (from acetone). Found (%): C, 32.23; H, 2.84; Br, 54.61; N, 6.49. C<sub>12</sub>H<sub>13</sub>Br<sub>3</sub>N<sub>2</sub>O. Calculated (%): C, 32.69; H, 2.97; Br, 54.36; N, 6.35. IR,  $\nu/cm^{-1}$ : 2920 (CH<sub>2</sub>); 1625 (C=N); 1580 (C=C); 720 (C–Br). <sup>1</sup>H NMR,  $\delta$ :

3.56 (s, 6 H, Me); 5.02 (s, 2 H, CH<sub>2</sub>); 6.84 (s, 1 H, =CHBr); 7.68–7.86 (m, 4 H, C<sub>6</sub>H<sub>4</sub>). <sup>13</sup>C NMR,  $\delta$ : 56.3 (Me); 57.8 (CH<sub>2</sub>); 95.7 (=CHBr); 126.7–132.7 (C<sub>6</sub>H<sub>4</sub>); 139.7 (C=CHBr); 157.4 (C=N). <sup>15</sup>N NMR (relative to MeNO<sub>2</sub> as the standard),  $\delta$ : –117.6 (N=C); –289.0 (N<sup>+</sup>Me<sub>2</sub>).

The filtrate was concentrated, cold diethyl ether was added with vigorous stirring, and the mixture was cooled to 0 °C. The precipitate that formed was filtered off, washed with cold ether, and dried *in vacuo*. The yield of compound **3b** was 1.37 g (32%), pink crystals, m.p. 156–157 °C. Found (%): C, 32.49; H, 3.22; Br, 53.95; N, 6.56. C<sub>12</sub>H<sub>13</sub>Br<sub>3</sub>N<sub>2</sub>O. Calculated (%): C, 32.69; H, 2.97; Br, 54.36; N, 6.35. IR,  $\nu/cm^{-1}$ : 3420 (NH); 2930 (CH<sub>2</sub>); 2240 (C≡C); 1640 (C=O); 680 (C–Br). <sup>1</sup>H NMR,  $\delta$ : 3.53 (s, 6 H, Me); 4.91 (s, 2 H, CH<sub>2</sub>); 7.68–7.88 (m, 4 H, C<sub>6</sub>H<sub>4</sub>); 10.68 (s, 1 H, NH).

**6-Bromomethylidene-2-(2-chlorophenyl)-4,4-dimethyl-5H-1,3,4-oxadiazinium bromide (2c)** was obtained as described for compound **2b** from 1-(2-chlorobenzoyl)-2,2-dimethylhydrazine (**1c**) (4.0 g, 0.02 mol) and 1,3-dibromopropyne (3.96 g, 0.02 mol) in MeCN. The yield of compound **2c** was 3.26 g (41%), white crystals, m.p. 170–172 °C (from MeCN). Found (%): C, 36.27; H, 3.88; Br, 40.44; Cl, 9.32; N, 7.08. C<sub>12</sub>H<sub>13</sub>Br<sub>2</sub>ClN<sub>2</sub>O. Calculated (%): C, 36.26; H, 3.55; Br, 40.20; Cl, 9.07; N, 7.05. IR,  $\nu/cm^{-1}$ : 2925 (CH<sub>2</sub>); 1630 (C=N); 1590 (C=C); 740 (C–Cl). <sup>1</sup>H NMR,  $\delta$ : 3.55 (d, 6 H, Me); 5.08 (d, 2 H, CH<sub>2</sub>); 6.85 (s, 1 H, =CHBr); 6.85–7.67 (m, 4 H, C<sub>6</sub>H<sub>4</sub>). <sup>13</sup>C NMR,  $\delta$ : 55.4 (Me); 57.2 (CH<sub>2</sub>); 95.6 (=CHBr); 126.6–134.0 (C<sub>6</sub>H<sub>4</sub>); 139.2 (C=CHBr); 157.8 (C=N).

**6-Bromomethylidene-4,4-dimethyl-2-(4-tolyl)-5H-1,3,4-oxadiazinium bromide (2d)** was obtained analogously from 2,2-dimethyl-1-(4-tolyl)hydrazine (**1d**) (1.0 g, 56 mmol) and 1,3-dibromopropyne (1.1 g, 56 mmol) over 7 h. The yield of compound **2d** was 1.5 g (71%), white crystals, m.p. 144–145 °C (from MeCN). Found (%): C, 41.40; H, 4.48; Br, 42.82; N, 7.20. C<sub>13</sub>H<sub>16</sub>Br<sub>2</sub>N<sub>2</sub>O. Calculated (%): C, 41.49; H, 4.25; Br, 42.55; N, 7.45. IR,  $\nu/cm^{-1}$ : 2921 (CH<sub>2</sub>); 1614 (C=N); 1568 (C=C); 683 (C–Br). <sup>1</sup>H NMR,  $\delta$ : 3.15 (s, 3 H, C<sub>6</sub>H<sub>4</sub>–Me); 3.50 (s, 6 H, NMe<sub>2</sub>); 4.88 (d, 2 H, CH<sub>2</sub>, *J* = 6.0 Hz); 6.78 (s, 1 H, =CHBr); 7.43–7.87 (m, 4 H, C<sub>6</sub>H<sub>4</sub>). <sup>13</sup>C NMR,  $\delta$ : 21.3 (C<sub>6</sub>H<sub>4</sub>–CH<sub>3</sub>); 55.9 (N–Me); 57.5 (CH<sub>2</sub>); 94.9 (=CHBr); 124.0–129.7 (C<sub>6</sub>H<sub>4</sub>); 144.6 (C=CHBr); 157.4 (C=N).

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