

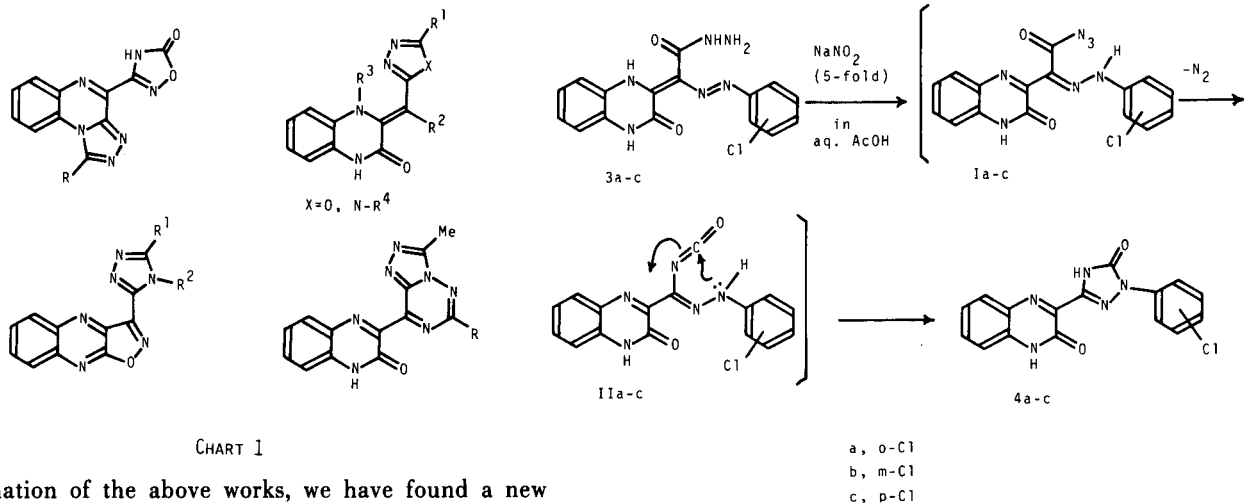
A New Method for the Synthesis of  
Novel 1-Aryl-3-quinoxaliny-1,2,4-triazol-5-ones  
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The reactions of 3-methoxycarbonylmethylene-2-oxo-1,2,3,4-tetrahydroquinoxaline **1** with aryl diazonium salts gave 3-( $\alpha$ -aryldiazenylmethoxycarbonylmethylene)-2-oxo-1,2,3,4-tetrahydroquinoxalines **2a-c**, whose reactions with hydrazine hydrate afforded 3-( $\alpha$ -aryldiazenylhydrazinocarbonylmethylene)-2-oxo-1,2,3,4-tetrahydroquinoxalines **3a-c**. The reactions of **3a-c** with nitrous acid resulted in the Curtius rearrangement to provide the 1-aryl-3-quinoxaliny-1,2,4-triazol-5-ones **4a-c**.

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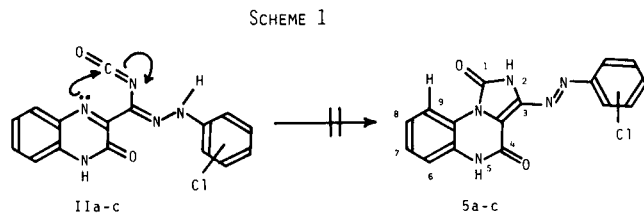
Recently, we have synthesized various oxadiazoles [1-3] and triazoles [4-6] from the interest in their pharmacological activities as the bactericidal, fungicidal and herbicidal agents [1a,4a]. The azoles synthesized by us include the quinoxaline moiety in their molecules, and some of the representative compounds are shown in Chart 1. In



continuation of the above works, we have found a new route to the synthesis of the 1-aryl-3-quinoxaliny-1,2,4-triazol-5-ones **4a-c**. This paper describes a new method for the synthesis of the novel 1,2,4-triazoles **4a-c**.

The reactions of the ester **1** with aryl diazonium salts resulted in the methylenic C-diazotization [1-9] to give the  $\alpha$ -aryldiazenylesters **2a-c**, whose reactions with hydrazine hydrate afforded the  $\alpha$ -aryldiazenylhydrazides **3a-c**. The reactions of **3a-c** with nitrous acid effected the Curtius rearrangement [2,10] to provide the 1,2,4-triazoles **4a-c**, presumably via intermediates **Ia-c** and **IIa-c**. These results are formulated in Scheme 1.

The above intermediates **IIa-c** predominantly cyclized into the 1,2,4-triazoles **4a-c** under the present reaction conditions, which would not favor the cyclizations of **IIa-c** into the imidazo[1,2-*a*]quinoxalines **5a-c** (Scheme 2). Whereas the pmr spectra of **5a-c** were expected to exhibit the C<sup>9</sup>-H proton signals in much lower magnetic fields



than the other aromatic proton signals due to anisotropy by the adjacent C=O groups [10-12], the pmr spectra of **4a-c** did not display the above anisotropy, but showed all the aromatic proton signals as one-grouped multiplets. Therefore, these pmr spectral data reasonably support the structures **4a-c**.

## EXPERIMENTAL

## General Procedure.

3-[ $\alpha$ -(*o*-Chlorophenyldiazanyl)methoxycarbonylmethylene]-2-oxo-1,2,3,4-tetrahydroquinoxaline (**2a**).

A solution of sodium nitrite (6.9 g, 0.10 mole) in water (50 ml) was added to a suspension of *o*-chloroaniline hydrochloride (19.56 g, 0.12 mole) in 10% hydrochloric acid (50 ml)/water (100 ml) with stirring in an ice-water bath to give a clear solution, which was added to a suspension of **1** (20 g, 0.092 mole) in acetic acid (100 ml)/water (200 ml) with stirring in an ice-water bath to precipitate yellow crystals **2a**. Stirring was continued for additional 10 minutes. The suspension was heated on a boiling water bath for 30 minutes. After the reaction mixture was cooled to room temperature, the yellow crystals **2a** were collected by suction filtration (29.3 g, 90%).

Compounds **2b** (19.49 g, 60%) and **2c** (20.46 g, 63%) were obtained by a similar manner to the above.

Recrystallization from *N,N*-dimethylformamide/ethanol gave orange needles **2a-c**, mp 241-242° (**2a**), 240-241° (**2b**), 250-251° (**2c**); ir:  $\nu$  cm<sup>-1</sup> 1720, 1665 (**2a**), 1745, 1665 (**2b**), 1720, 1665 (**2c**); ms: *m/z* 356 (M<sup>+</sup>), 358 (M<sup>+</sup>+2) (**2a-c**); pmr (deuteriodimethylsulfoxide):  $\delta$  13.72 (s, 1H, NH), 12.83 (s, 1H, NH), 8.00-6.93 (m, 8H, aromatic), 3.83 (s, 3H, Me) (**2a**);  $\delta$  12.67 (s, 1H, NH), 11.15 (s, 1H, NH), 8.00-6.90 (m, 8H, aromatic), 3.75 (s, 3H, Me) (**2b**);  $\delta$  12.64 (s, 1H, NH), 11.17 (s, 1H, NH), 8.00-7.17 (m, 8H, aromatic), 3.73 (s, 3H, Me) (**2c**).

*Anal.* Calcd for C<sub>17</sub>H<sub>13</sub>ClN<sub>5</sub>O<sub>2</sub>: C, 57.23; H, 3.67; N, 15.70. Found: C, 57.11; H, 3.51; N, 15.89 (**2a**); C, 57.21; H, 3.55; N, 15.81 (**2b**); C, 57.10; H, 3.61; N, 15.80 (**2c**).

3-[ $\alpha$ -(*o*-Chlorophenyldiazanyl)hydrazinocarbonylmethylene]-2-oxo-1,2,3,4-tetrahydroquinoxaline (**3a**).

A suspension of **2a** (10 g, 0.028 mole) and hydrazine hydrate (14 g, 0.28 mole) in ethanol (500 ml) was refluxed on a boiling water bath for 3 hours to precipitate yellow needles **3a** as hydrazinium salt, which was collected by suction filtration (9.38 g). The filtrate was evaporated *in vacuo* to provide an additional product **3a** (1.25 g). Total yield, 10.63 g (98%).

Compounds **3b** (hydrazinium salt) (8.41 g, 77%) and **3c** (free base) (7.97 g, 80%) were obtained by a similar manner to the above.

Trituration with hot ethanol gave analytically pure yellow needles **3a-c**, mp 325-326° (**3a**), 289-290° (**3b**), 308-309° (**3c**); ir:  $\nu$  cm<sup>-1</sup> 3250, 1580 (**3a**), 3250, 1585 (**3b**), 3250, 1665 (**3c**); ms: *m/z* 356 (M<sup>+</sup>), 358 (M<sup>+</sup>+2) (**3a-c**); pmr (deuteriodimethylsulfoxide):  $\delta$  8.00-6.70 (m, 8H, aromatic), 5.27 (br, NH and H<sub>2</sub>O) (**3a**);  $\delta$  9.33 (br, 1H, NH), 8.00-6.67 (m, 8H, aromatic), 5.37 (br, NH and H<sub>2</sub>O) (**3b**);  $\delta$  10.53 (s, 1H, NH), 9.43 (s, 1H, NH), 8.00-7.17 (m, 8H, aromatic), other NH proton signals were overlapped with aromatic proton signals (**3c**).

*Anal.* Calcd for C<sub>16</sub>H<sub>11</sub>ClN<sub>5</sub>O<sub>2</sub> (**3a,b**): C, 49.43; H, 4.41; N, 28.82. Found: C, 49.72; H, 4.36; N, 28.83 (**3a**); C, 49.48; H, 4.31; N, 28.56 (**3b**).

*Anal.* Calcd for C<sub>16</sub>H<sub>11</sub>ClN<sub>5</sub>O<sub>2</sub> (**3c**): C, 53.87; H, 3.67; N, 23.56. Found: C, 53.96; H, 3.64; N, 23.28 (**3c**).

1-(*o*-Chlorophenyl)-3-(3-oxo-3,4-dihydroquinoxalin-2-yl)-4,5-dihydro-1*H*-1,2,4-triazol-5-one (**4a**)

A solution of sodium nitrite (2.66 g, 0.039 mole) in water (30 ml) was added to a suspension of **3a** (3 g, 0.0077 mole) in acetic acid (100 ml)/water (20 ml) with stirring in an ice-water bath. The suspension was heated on a boiling water bath for 2 hours to precipitate yellow crystals **4a**, which were collected by suction filtration (1.06 g). Evaporation of the filtrate *in vacuo* to provide an additional product **4a** (1.45 g). Total yield, 2.51 g (88%).

Compounds **4b** (1.82 g, 64%) and **4c** (1.52 g, 53%) were obtained by a similar manner to the above.

Trituration with hot *N,N*-dimethylformamide/ethanol gave analytically pure samples **4a-c**, mp 334° dec (**4a**), above 350° (**4b**), above 350° (**4c**); ir:  $\nu$  cm<sup>-1</sup> 1680 (**4a**), 1695, 1660 (**4b**), 1695, 1660 (**4c**); ms: *m/z* 339 (M<sup>+</sup>), 341 (M<sup>+</sup>+2) (**4a-c**); pmr (deuteriodimethylsulfoxide):  $\delta$  12.83 (s, 1H, NH), 12.30 (s, 1H, NH), 8.10-6.83 (m, 8H, aromatic) (**4a**); (trifluoroacetic acid):  $\delta$  8.33-7.33 (m, 8H, aromatic) (**4b**); (trifluoroacetic acid):  $\delta$  8.33-7.33 (m, 8H, aromatic) (**4c**). NH proton signals were not observed in **4b** and **4c**.

*Anal.* Calcd for C<sub>16</sub>H<sub>10</sub>ClN<sub>5</sub>O<sub>2</sub>: C, 56.57; H, 2.97; N, 20.73. Found: C, 56.67; H, 3.05; N, 20.62 (**4a**); C, 56.40; H, 2.85; N, 20.73 (**4b**); C, 56.72; H, 2.88; N, 20.88 (**4c**).

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