

# Synthesis of 2-Methyl-1-phenylthiocarbamoylglyoxal Arylhydrazones and Diethyl(arylazo)(phenylthiocarbamoyl)malonate and their Reactions with Hydrazines

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Hydrazines, Pyrazoles, Arylhydrazones

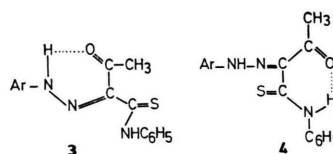
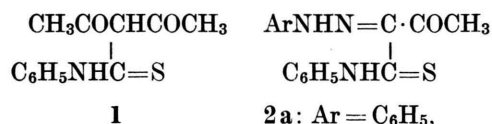
Treatment of  $\alpha$ -phenylthiocarbamoyl acetyl acetone (**1**) with aromatic diazonium salts effects acetyl cleavage with the formation of 2-methyl-1-phenylthiocarbamoylglyoxal arylhydrazones (**2a-c**), which afford the anilinopyrazoles (**5a-c**) and the phenylimino-2-pyrazolines (**6a-c**) on treatment with hydrazine or phenyl hydrazine respectively.

Treatment of diethyl  $\alpha$ -phenylthiocarbamoyl malonate with aryl diazonium salts gave diethyl (arylazo)(phenylthiocarbamoyl) malonate which afford the 7-phenyl-5-(arylazo)-2,3,7-triazabicyclo[3,2,0]hept-1-ene-4,6-dione (**9a, b**) and its 3-phenyl derivatives (**9c, d**) with hydrazines and phenyl hydrazine respectively.

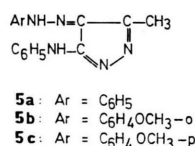
In continuation of our previous studies [1] on the pyrazoles and pyrazolines synthesis, this work describes the use of Japp-Klingemann [2] reaction in the preparation of several new derivatives containing the pyrazole and pyrazoline nucleus.

Substituted- $\beta$ -keto-esters and  $\beta$ -diketones when allowed to react with diazonium salts in alkaline medium undergo base catalysed cleavage of an acyl group with the formation of monohydrazones. This reaction is known as Japp-Klingemann [2] reaction. A number of  $\alpha$ -substituted derivatives of  $\beta$ -ketoesters [3-6] and  $\beta$ -diketones [7-12] are reported to undergo acyl-group cleavage when treated with diazonium salts. The behaviour of  $\alpha$ -phenylthiocarbamoylacetylacetone (**1**) [13] and diethyl  $\alpha$ -phenylthiocarbamoylmalonate (**7**) towards the action of diazonium salts has been studied.

Treatment of **1** with the appropriate aromatic diazonium salt in presence of sodium acetate also effected acetyl-group cleavage with the formation of the arylhydrazono derivatives (**2a-c**) as inferred from their correct analytical data. The IR spectra of **2a**, taken as example, showed absorption at 1550 (C=N), 1710 (CO) and 3350  $\text{cm}^{-1}$  (NH). The low carbonyl absorption may be due to the possible hydrogen bonding (cf. structures **3** and **4**).

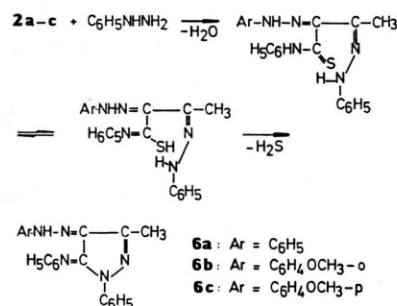


It is no evident that the acetyl group is cleaved in preferential to the thiocarbamoyl group. When the arylhydrazono derivatives (**2a-c**) were warmed with hydrazine hydrate, afforded a deeply coloured product, the analytical data of which are inagreement with 3-anilino-4-aryl-hydrazono-5-methyl-pyrazoles (**5a-c**).

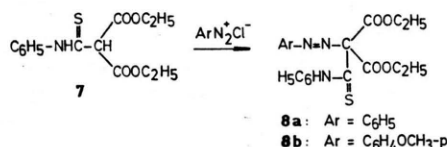


The formation of **5a-c** may have involved the condensation of the two, thiocarbamoylthione and the acetyl carbonyl groups with hydrazine. Also, treatment of **2a-c** with phenylhydrazine afforded the corresponding 4-arylhydrazone-1-phenyl-3-methyl-5-phenylimino-2-pyrazolines (**6a-c**). The formation of the latter compounds involves the condensation of the acetyl carbonyl group with phenylhydrazine followed by the cyclization of the intermediately formed hydrazone derivatives with loss of hydrogen sulphide.

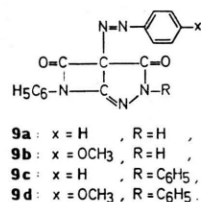
Requests for reprints should be sent to Dr. F. Abdel-Kader Amer, Department of Chemistry, Faculty of Science, Mansoura University, Mansoura, A.R. Egypt.



This investigation has been extended to study the behaviour of  $\alpha$ -phenylthiocarbamoyl derivative of ethylmalonate (7) towards the action of diazonium salts under the same conditions, the arylazo derivatives (8a, b) were obtained. Structure 8 was inferred from the correct analytical data and the appearance of carbonyl and NH absorptions in their IR spectra. It is noteworthy that no group cleavage has taken place in this case, and consequently the products are typical azo derivatives and not hydrazones



Treatment of the arylazo derivatives 8a, b with hydrazine hydrate or phenylhydrazine afforded deeply coloured products for which structure 9a-d are tentatively given based on analytical data and mass spectral data which revealed that the reaction has involved one molecule of the hydrazine with loss of two ethanol molecules and hydrogen sulphide.



The mass spectra of 9c, d obtained upon electron impact 70 eV, showed that the molecular ions ( $m/e$  381, 411) respectively are the base peak. The fragmentation pathways are nearly the same in both compounds as shown in Fig. 1. However, the only difference between the mass spectra is that the second one contains an intense peak at  $m/e$ -149 (80%). It is suggested that this fragment ion is

formed from a fragment containing the methoxy group through a complex mechanism.

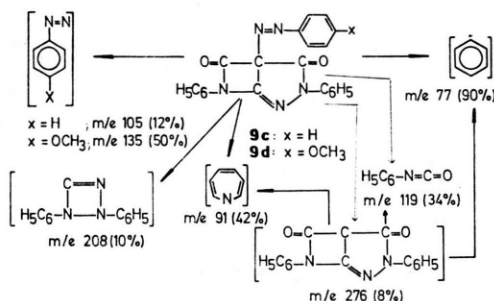


Fig. 1. Fragmentation pathways.

### Experimental

All melting points are uncorrected. IR spectra were determined on KBr discs using a Unicam SP 1000 IR spectrophotometer. The mass spectra were recorded on a Jeol D-100 mass spectrometer using the direct inlet probe. The machine was operated at a bombardment energy of 70 eV and with a source temperature of 200 °C.

#### Reaction of $\alpha$ -phenylthiocarbamoylacetone (1) with diazonium salts

To a cold solution of 1 [13] (0.01 mole) in ethanol (40 ml), sodium acetate (0.01 mole) was added and the mixture was stirred for a few minutes. The appropriate freshly prepared aromatic diazonium salt (0.01 mole) was added gradually with continuous stirring.

The solid product 2a-c that separated was filtered off and crystallized from ethanol.

2a formed orange crystals, m.p. 110 °C, yield 40%.

$C_{16}H_{15}ON_3S$

|       |         |        |         |          |
|-------|---------|--------|---------|----------|
| Found | C 64.59 | H 5.38 | N 14.20 | S 10.68, |
| Calcd | C 64.64 | H 5.05 | N 14.10 | S 10.77. |

2b formed red crystals, m.p. 174 °C, yield 80%.

$C_{17}H_{17}O_2N_3S$

|       |         |        |         |         |
|-------|---------|--------|---------|---------|
| Found | C 62.10 | H 5.62 | N 13.11 | S 10.2, |
| Calcd | C 62.36 | H 5.24 | N 12.83 | S 9.79. |

2c formed reddish brown crystals m.p. 104 °C, yield 50%.

$C_{17}H_{17}O_2N_3S$

|       |         |        |         |         |
|-------|---------|--------|---------|---------|
| Found | C 62.00 | H 5.4  | N 12.91 | S 9.29, |
| Calcd | C 62.36 | H 5.24 | N 12.83 | S 9.79. |

#### Action of hydrazine hydrate on 2a-c

A mixture of 2a-c (0.01 mole), hydrazine hydrate (0.01 mole) and ethanol (50 ml), was refluxed for two h and the solid product 5a-c, that separated on cooling, was filtered off and crystallized from ethyl alcohol. The resulting 3-anilino-4-arylhydrazone-5-methylpyrazoles (5a-c) are as follows:

5a formed yellow crystals, m.p. 219 °C, yield 55%.

$C_{16}H_{15}N_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 69.46 | H 5.09 | N 25.41, |
| Calcd | C 69.31 | H 5.41 | N 25.27. |

**5b** formed orange crystals, m.p. 215 °C, yield 70%.

 $C_{17}H_{17}ON_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 66.81 | H 5.99 | N 22.32, |
| Calcd | C 66.44 | H 5.53 | N 22.80. |

**5c** formed brown crystals, m.p. 164 °C, yield 40%.

 $C_{17}H_{17}ON_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 66.09 | H 5.72 | N 23.01, |
| Calcd | C 66.44 | H 5.53 | N 22.8.  |

*Action of phenylhydrazine on 2a-c*

A mixture of each of **2a-c** (0.01 mole) and phenylhydrazine (0.02 mole) was heated in an oil-bath at 260 °C for 4 h. The residue was triturated with dilute alcohol and the resulting solid product **6a-c** was recrystallized from ethanol to give 4-arylhydrazono-3-methyl-5-phenylimino-2-pyrazolines as follows:

**6a** formed red crystals, m.p. 103 °C, yield 40%.

 $C_{22}H_{19}N_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 74.9  | H 5.81 | N 19.66, |
| Calcd | C 74.78 | H 5.38 | N 19.83. |

**6b** formed red crystals, m.p. 110 °C, yield 70%.

 $C_{23}H_{21}ON_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 72.46 | H 5.28 | N 18.61, |
| Calcd | C 72.06 | H 5.48 | N 18.27. |

**6c** formed red crystals, m.p. 137 °C, yield 60%.

 $C_{23}H_{21}ON_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 72.14 | H 5.50 | N 18.22, |
| Calcd | C 72.06 | H 5.48 | N 18.27. |

*Reaction of diethyl  $\alpha$ -phenylthiocarbamoyl malonate (7) with diazonium salts*

To a cold solution of **7** (0.01 mole) in ethanol (40 ml), sodium acetate (0.01 mole) was added and the mixture was stirred for a few minutes. The appropriate freshly prepared aromatic diazonium salt (0.01 mole) was added gradually with continuous stirring. The solid product, that separated was

filtered off and crystallised from ethanol to give diethyl(phenylthiocarbamoyl)(aryldazo)malonate (**8a, b**).

**8a** formed red crystals, m.p. 167 °C.

 $C_{20}H_{21}O_4N_3S$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 60.28 | H 5.48 | N 10.39, |
| Calcd | C 60.15 | H 5.01 | N 10.21. |

**8b** formed violet crystals, m.p. 179 °C, yield 70%.

 $C_{21}H_{23}O_5N_3S$ 

|       |         |        |         |
|-------|---------|--------|---------|
| Found | C 59.22 | H 5.32 | N 9.9,  |
| Calcd | C 58.74 | H 5.35 | N 9.79. |

*Action of hydrazine hydrate and phenylhydrazine on 8a, b*

A mixture of each of **8a, b** (0.01 mole), hydrazine hydrate or phenylhydrazine (0.01 mole) and ethanol (50 ml) was refluxed on a water bath (in case of hydrazine hydrate) put in an oil bath (in case of phenylhydrazine) for 2 h and the solid product that separated on cooling was filtered off and crystallised from ethyl alcohol. The results obtained are as follows.

**9a** formed brown crystals, m.p. 220 °C, yield 30%.

 $C_{16}H_{11}O_2N_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 62.81 | H 3.98 | N 22.49, |
| Calcd | C 62.95 | H 3.60 | N 22.95. |

**9b** formed yellowish brown crystals, m.p. 246 °C, yield 30%.

 $C_{17}H_{13}O_3N_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 61.01 | H 3.76 | N 20.82, |
| Calcd | C 60.89 | H 3.88 | N 20.89. |

**9c** formed deep brown crystals, m.p. 243 °C, yield 40%.

 $C_{22}H_{15}O_2N_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 69.38 | H 3.98 | N 16.39, |
| Calcd | C 69.29 | H 3.93 | N 16.11. |

**9d** formed deep brown crystals, m.p. 239 °C, yield 30%.

 $C_{23}H_{17}O_3N_5$ 

|       |         |        |          |
|-------|---------|--------|----------|
| Found | C 67.39 | H 4.30 | N 10.48, |
| Calcd | C 67.15 | H 4.13 | N 10.70. |

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