

THE *p*-BENZOQUINONE OXIDATION  
OF HEXAHYDRO-1,2,4-TRIAZINE-3,5-DIONE\*

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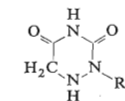
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Hexahydro-1,2,4-triazine-3,5-dione (*Ia*) affords 2,3,4,5-tetrahydro-1,2,4-triazine-3,5-dione (*IIa*) by reaction with sodium nitrite, sodium perchlorate, and ferric chloride. In this oxidation as well as in the oxidation of 1-benzylhexahydro-1,2,4-triazine-3,5-dione (*Ib*) to the tetrahydro derivative *IIb* and of 1-benzylsemicarbazide (*III*) to benzylidene semicarbazide (*IV*), *p*-benzoquinone is the selective reagent of choice.

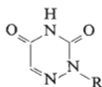
In connection with investigations<sup>1,2</sup> on reactions of hexahydro-1,2,4-triazine-3,5-dione (dihydro-6-azauracil, *Ia*) it was also of interest to examine the reverse oxidation (dehydrogenation) of this compound to 2,3,4,5-tetrahydro-1,2,4-triazine-3,5-dione (6-azauracil, *IIa*). This reaction leading to a more stable quasiheteroaromatic system *IIa* may be assumed to occur readily. For the use with polyfunctional derivatives, however, it was desirable to find selective reagents acting under mild conditions.

The literature reports dehydrogenation of compound *Ia* and its 6-methyl derivative by the action of bromine in water with the formation of compound *IIa* or the corresponding 6-methyl derivative<sup>3,4</sup>. We have observed that the same reaction may be accomplished with sodium nitrite in acetic acid, sodium perchlorate or ferric chloride as oxidants. In all these cases, the tetrahydro derivative *IIa* was obtained in fair yields as the single product. The competitive formation of nitroso compounds



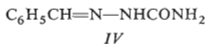
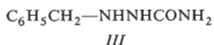
*Ia*, R = H

*Ib*, R = CH<sub>2</sub>C<sub>6</sub>H<sub>5</sub>



*IIa*, R = H

*IIb*, R = CH<sub>2</sub>C<sub>6</sub>H<sub>5</sub>



\* Part V in the series Chemistry of 1,2,4-Triazine; Part IV: This Journal 38, 934 (1973).

or isomeric oximes as by-products or intermediates has not been encountered in the sodium nitrite oxidation. All the above agents may be successfully used in the case of compound *Ia* and its homologues; with functional derivatives, however, some complications could be expected due to additional oxidations. In this respect, *p*-benzoquinone has proved as an advantageous selective oxidant for the transformation of hexahydro derivatives *I* to the tetrahydro derivatives *II*. By refluxing compound *Ia* or its benzyl derivative *Ib* with *p*-benzoquinone in ethanol or acetic acid, compounds *IIa* and *IIb*, resp., were obtained in fair yields. The starting benzyl derivative *Ib* was prepared by reduction of compound *IIb* with zinc in aqueous acetic acid. *p*-Benzoquinone as dehydrogenation agent may also be used in the case of aliphatic compounds with a similar arrangement on the C—N bond, as exemplified on the conversion of 1-benzylsemicarbazide (*III*) to benzylidene semicarbazide (*IV*).

## EXPERIMENTAL

Melting points were taken on a heated microscope stage (Kofler block). Analytical samples were dried at 60°C/20 Torr for 5 h.

### 2,3,4,5-Tetrahydro-1,2,4-triazine-3,5-dione (*IIa*)

*A.* To a solution of compound *Ia* (5.75 g; 0.05 mol) in water (100 ml) and acetic acid (20 ml) there was added dropwise at 5–10°C over 30 min a solution of sodium nitrite (10.35 g; 0.15 mol) in water (50 ml), the mixture stirred at room temperature for 5 h, the solid collected with suction, washed with water, and recrystallised from water (75 ml) to afford 4.5 g (79%) of compound *IIa*, m.p. 281–282°C, undepressed on admixture with an authentic specimen.

*B.* Compound *Ia* (5.75 g; 0.05 mol) was dissolved in hot water (130 ml), the solution cooled down, and treated dropwise at 20°C over 30 min with a solution of sodium perchlorate (3.82 g; 0.051 mol) in water (20 ml). The mixture was stirred at room temperature for 6 h, the solid collected with suction, washed with water, and recrystallised from water (70 ml) previously adjusted to pH 3 with hydrochloric acid. Yield, 4.6 g (81%) of compound *IIa*, m.p. 280–282°C.

*C.* To a solution of compound *Ia* (5.75 g; 0.05 mol) in water (50 ml) there was added dropwise at 70–80°C over 30 min a solution of ferric chloride (17.82 g; 0.11 mol) in water (50 ml), the resulting mixture stirred at the same temperature for 4 h, cooled down, and processed analogously to paragraph *A*. Yield, 4.35 g (77%) of compound *IIa*, m.p. 280–282°C.

*D.* A solution of compound *Ia* (2.87 g; 0.025 mol) and *p*-benzoquinone (2.7 g; 0.025 mol) in acetic acid (20 ml) was refluxed for 2 h and then kept at room temperature for 10 h. The solid was collected with suction, washed with ethanol, and recrystallised from water (20 ml) to afford 2.22 g (78%) of compound *IIa*, m.p. 280–282°C.

### 2-Benzylhexahydro-1,2,4-triazine-3,5-dione (*Ib*)

To a suspension of 2-benzyl-2,3,4,5-tetrahydro-1,2,4-triazine-3,5-dione<sup>5</sup> (*Ib*; 4.06 g; 0.02 mol) and zinc (4 g) in water (50 ml), there was added dropwise at 70–80°C over 15 min acetic acid (50 ml) and the whole was refluxed with stirring for 5 h. The excess zinc was filtered off, the filtrate concentrated to half of the original volume, and the concentrate cooled down. The solid was collected with suction and recrystallised from water (250 ml) to afford 3.19 g (78%) of compound

*Ib*, m.p. 175—176°C. For  $C_{10}H_{11}N_3O_2$  (205.2) calculated: 58.53% C, 5.40% H, 20.48% N; found: 58.35% C, 5.31% H, 20.21% N.

2-Benzyl-2,3,4,5-tetrahydro-1,2,4-triazine-3,5-dione (*Iip*)

A solution of compound *Ib* (2.05 g; 0.01 mol) and *p*-benzoquinone (1.08 g, 0.01 mol) in acetic acid (20 ml) was processed analogously to the preparation of compound *Iia*, procedure *D*. Yield, 1.56 g (77%) of compound *Iib*, m.p. 182—183°C, undepressed on admixture with an authentic specimen<sup>5</sup>.

Benzylidenesemicarbazide (*IV*)

1-Benzylsemicarbazide (*III*; 3.3 g; 0.02 mol) was oxidized with *p*-benzoquinone (2.16 g; 0.02 mol) analogously to the preparation of compound *Iia*, procedure *D*. Yield, 2.64 g (81%) of compound *IV*, m.p. 215—219°C, undepressed on admixture with an authentic specimen<sup>6</sup>.

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