REDUCTIVE REARRANGEMENTS OF THE RETROBENZILIC ACID TYPE INDUCED BY LEWIS ACIDS–IX[a]

THE REACTION OF 5,5-DIPHENYL-2,4-THIAZOLIDINEDITHIONE WITH ALUMINIUM CHLORIDE AND TOLUENE

E. Koltai,[b] J. Nyitrai and K. Lempert*
Department of Organic Chemistry, Technical University, Budapest XI

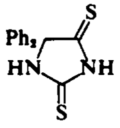
(*Received in UK* 5 *January* 1973; *Accepted for publication* 5 *April* 1973)

Abstract—5,5-Diphenyl-2,4-thiazolidinedithione (**3a**), when refluxed with anhydrous $AlCl_3$ in toluene, is desulfurated and rearranged to 4,5-diphenyl-4-thiazoline-2-thione (**4**). Neither 2,2-diphenyl-1,4,2H-benzothiazine-3(4H)-thione (**5b**) nor its S-Me derivative (**6**) are changed on similar treatment.

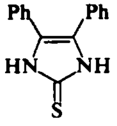
Zusammenfassung—Beim Kochen mit Toluol in Gegenwart von wasserfreiem $AlCl_3$ wird das 5,5-Diphenyl-2,4-thiazolidindithion (**3a**) zum 4,5-Diphenyl-4-thiazolin-2-thion (**4**) desulfiert und umgelaggert. Weder das 2,2-Diphenyl-1,4,2H-benzthiazin-3(4H)-thion (**5b**) noch sein S-Methyl-Derivat (**6**) erfahren unter den gleichen Bedingungen eine analoge Änderung.

In previous papers, 5,5-diphenyldithiohydantoin (**1**)[1] and related imidazole derivatives[2] were shown to undergo in the presence of aluminium chloride a 1:2 phenyl shift under extrusion of sulfur or of a sulfur containing group to yield 4,5-diphenyl-4-imidazoline-2-thione (**2**) and the corresponding related compounds, respectively.

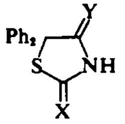
In order to see whether similar rearrangements could be brought about with thioxo derivatives of other heterocyclic systems, 5,5-diphenyl-2,4-thiazolidine-dithione (**3a**) was selected.



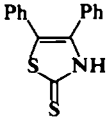
1



2



	X	Y
3a:	S	S
b:	NH	O
c:	O	O
d:	S	O
e:	O	S

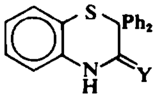


4

The key intermediate for the synthesis of **3a** was the dioxo analogue **3c**[3] which could be obtained starting with α-chloro-α,α-diphenylacetic acid by modifications of known procedures[3,4a] through the iminothiazolidinone **3b**.[4] Thiation of **3c** with phosphorus pentasulfide in refluxing dioxane† gave the monothio derivative **3d** whose structure was based on an alternative synthesis by reacting α-chloro-α,α-diphenylacetic acid with ammonium dithiocarbamate. Traces of the dithio compound **3a**, but none of the isomeric monothio derivative **3e** were formed under the above thiation conditions.

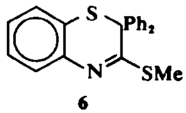
When **3d** was heated with phosphorus pentasulfide to 180° in tetraline a complex mixture was obtained from which the desired **3a** was separated by repeated recsystallizations and TLC. When treated with $AlCl_3$ in boiling anhydrous toluene it transformed into **4**, identical by IR spectrum with an authentic sample prepared by reacting α-bromodeoxybenzoin with ammonium dithiocarbamate.[5]

Extension of the desulfuration-rearrangement to 2,2-diphenyl-1,4,2H-benzothiazine-3(4H)-thione (**5b** obtained by thiation of the corresponding oxo derivative **5a**) as well as to the S-Me derivative **6** of the former was also attempted. These two compounds, however, failed to react under the conditions applied.



5

a: Y = O
b: Y = S



6

---

[a] Part VIII: J. Fetter, J. Nyitrai, K. Lempert, *Tetrahedron* **27**, 5933 (1972).

[b] Chinoin Pharmaceutical Works (Budapest) research fellow, 1970–1972.

†When the solvent dioxane was replaced by pyridine a considerably less pure product resulted.

EXPERIMENTAL

2-Imino-5,5-diphenyl-4-thiazolidinone (**3b**)

A mixture of α-chloro-α,α-diphenylacetic acid (10 g; 40 mmoles), thiourea (4 g; 50 mmoles), anhyd NaOAc (1 g) and AcOH (75 ml) was refluxed for 30 min. The resulting mixture was treated with 5% Na_2CO_3 aq until faintly alkaline to yield 8·3 g (76%) of a colourless crystalline ppt of crude **3b**, which was recrystallized from about 15 times its weight of MeOH, mp: 286–7°, lit.[4b] m.p.: 282–3°.

5,5-Diphenyl-2,4-thiazolidinedione (**3c**)

(a) A mixture of **3b** (5·0 g; 19 mmoles), MeOH and conc HCl (70 ml each) was refluxed for 2·5 hr. On cooling, long crystalline needles and a brownish oil were deposited; on scratching, the latter became crystalline; 4·1 g (82%) **3c**, colourless needles, m.p. 152–3° (aqueous MeOH), lit.[3] m.p. 149–50°; IR (KBr) ν-CO-NH-CO- 1745 (m) + 1685 (s).

(b) A mixture of α-chloro-α,α-diphenylacetic acid (10 g; 40 mmoles), thiourea (4 g; 50 mmoles), anhyd NaOAc (1 g) and AcOH (75 ml) was refluxed for 45 min. After cooling, the mixture was diluted with 3 vols of water. The precipitated crystalline product (the crude hydrochloride of **3b**) was refluxed for 5 hr with a mixture of MeOH and conc HCl (150 ml, each) to yield 8·7 g (79%) of the colourless crystals of **3c**, m.p. 151–4° (aqueous MeOH).

5,5-Diphenyl-2-thioxo-4-thiazolidinone (**3d**)

(a) A mixture of **3c** (6·7 g; 25 mmoles), P_2S_5 (5·0 g; 25 mmoles) and dry dioxane (10 ml) was refluxed for 12 hr. On cooling, the precipitation of faint yellow crystals (5·6 g) was completed by the addition of water. The initial m.p. of 90–110° could be raised to repeated recrystallizations to 172–7°. According to FLC, however, even this material was contaminated with traces of **3c** and **3a**.

(b) Ammonium dithiocarbamate (16 g) was added in small portions to a soln of α-chloro-α,α-diphenylacetic acid (10 g) in MeOH (30 ml) chilled in ice water. The soln turned dark, and colourless crystals of NH_4Cl were precipitated. The filtrate and the methanolic washings of the latter were poured into boiling 20% HCl (200 ml) and the resulting gummy product was recrystallized from a small amount of EtOH to yield 3·7 g of crude **3d**, m.p. 160–74°. Another recrystallization from EtOH raised the m.p. to 178–80°. This product proved by mixed m.p., IR spectrum and TLC to be identical with the main component of the product obtained according to (a). (Found N, 5·00; S, 21·99. Calc'd for $C_{15}H_{11}NOS_2$ (285·38): N, 4·91; S, 21·99%); IR (KBr): Amide I 1710 cm^{-1}.

5,5-Diphenyl-2,4-thiazolidinedithione (**3a**)

A mixture of **3d** (1·4 g; 5 mmoles), P_2S_5 (1·1 g; 5 mmoles) and tetraline (10 ml) was heated for 2·5 hr at 180°. Light petroleum (about 2 vols) was added after cooling and the soln was decanted from the red gummy ppt. The solvent was evaporated and the red oily residue was extracted with boiling gasoline (about 15 ml). On standing overnight in a refrigerator, a small amount of the bright yellow crystals of **3a**, m.p. 135·8° separated. The product was further purified by preparative TLC (adsorbent: Kieselgel G, Merck; development: $CHCl_3$; elution: acetone) and recrystallization from gasoline; m.p. 135–8°. (Found N, 4·55; S, 31·77. Calc'd for $C_{15}N_{11}NS_3$(301·45): N, 4·65; s, 31·91 %); UV (EtOH): 250(3·98); 337(4·35); 470(3·83), sh.

4,5-Diphenyl-4-thiazoline-2-thione (**4**)

(a) A mixture of **3a** and anhyd $AlCl_3$ (0·15 g, each) and dry toluene (4 ml) was refluxed for 1 hr and subsequently poured into 20% HCl aq to yield colourless crystals of **4**, m.p. 203–5° (EtOH). The product was proved by its IR spectrum to be identical with the product obtained according to (b).

(b) An authentic sample of **4** was obtained according to the method of Ritter and Sokol;[5] m.p. and lit. m.p.: 214–6°.

2,2-Diphenyl-1,4,2H-benzothiazin-3(4H)-one (**5a**)

A mixture of *o*-aminothiophenol (12·5 g; 0·1 mole), α-chloro-α,α-diphenylacetic acid (24·6 g; 0·1 mole) and AcOH (360 ml) was refluxed for 15 min to yield 21·1 g (67%) of **5a**, m.p.: 239–40° (AcOH), lit.[6] m.p.: 239°; IR (KBr): Amide I 1680 cm^{-1}.

2,2-Diphenyl-1,4,2H-benzothiazine-3(4)-thione (**5b**)

A mixture of **5a** (4·5 g; 14 mmoles), P_2S_5(3·0 g; 13·5 mmoles) and xylene (30 ml) was refluxed for 3 hr under continuous stirring. The resulting soln was cooled and diluted with about twice its volume of light petroleum to give an abundant ppt of yellow crystals which were thoroughly washed with light petroleum and dried. The crude product was suspended in water and refluxed for 2 hr to yield 3·9 g (82%) of the yellowish crystals of **5b**, m.p. 233–5° (AcOH). (Found N, 4·28; S, 18·83. Calc'd for $C_{20}H_{15}NS_2$ (336·46): N, 4·20; S, 19·23%). No change occurred when this product was refluxed for 3 hr with 5 moles of anhyd $AlCl_3$ in xylene.

3-Methylthio-2,2-diphenyl-1,4,2H-benzothiazine (**6**)

MeI (2 ml; 30 mmoles) was added under continuous stirring to a suspension of **5b** (1·7 g; 5 mmoles) in MeOH (25 ml) containing NaOMe (5 mmoles). The mixture was stirred for another hr whereby the colour of the crystals turned white and the mixture became neutral. The yield amounted 1·5 g (85%), m.p. 178–80° (1-propanol). (Found N, 4·02; S, 18·02. Calc'd for $C_{21}H_{17}NS_2$ (347·49): N, 4·03; S 17·62%).

No change occurred when this product was refluxed with anhyd $AlCl_3$ in xylene.

REFERENCES

[1] K. Lempert, J. Nyitrai, *Tetrahedron Letters* No. 33, 2927 (1965); K. Lempert, J. Nyitrai, *Acta Chim. Acad. Sci. Hung.* **51**, 95 (1967)

[2] J. Nyitrai, K. Lempert, *Tetrahedron* **25**, 4265 (1969) and references cited

[3] H. Dannenberg, A. Rahman, *Chem. Ber.* **89**, 1625 (1956)

[4a] Yu. M. Pashkevich, *Farmatsevt. Zh.* **16**, No. 1, 8 (1961); *Chem. Absts.* **57**, 11182 (1962)

[4b] H. Aspelund, *Acta Acad. Aboens. Math. Phys.* **24** (1), 23 (1964); *Chem. Abstr.* **64**, 6634 (1966)

[5] J. Ritter, H. Sokol, *J. Am. Chem. Soc.* **70**, 3419 (1948)

[6] Langlet, in *Beilsteins Handb. Org. Chem.* (Fourth edition) Hwk. Vol **27**, p. 229, Springer Verlag, Berlin (1937)