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Original scientific paper

OXIDATION OF THIOBENZANILIDE WITH PHENYLIODOSODIACETATE

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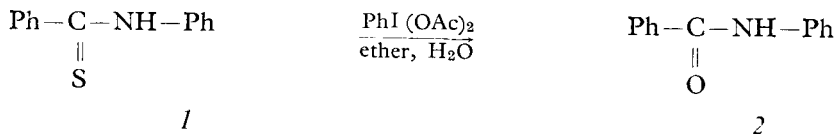
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The oxidation of thiobenzanilide with phenyliodosodiacetate in ether was investigated. It was found that when the oxidation was carried out in the absence of water, depending on the molar ratio, bis(α -phenyliminobenzyl)-sulphide or bis(α -phenyliminobenzyl)disulphide was obtained as a the final product, and in the presence of water benzanilide was obtained.

Various oxidizing agents have been used so far to oxidize thioamides. It has been found that different oxidation products can be obtained depending on the employed agent, the reaction condition and the nature of the thioamide itself. A detailed review of the pertinent studies up to 1961 has been given by Hurd and DeLaMater¹. The period up to 1971 has been reviewed by Petrov and Andreev² and a number of more recent papers³⁻¹⁸ also deal with the oxidation of thioamides.

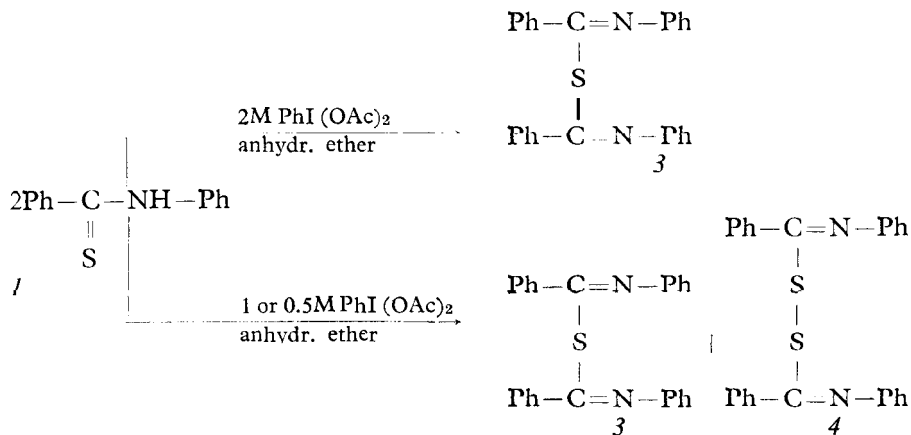
The aim of our present investigation was to study the oxidation of thiobenzanilide (1) in ether, both anhydrous (in the presence of acetic acid anhydride or anhydrous sodium carbonate) and containing water in various molar ratios. To the best of our knowledge, phenyliodosodiacetate which we used as an oxidizing agent, has not been employed as an oxidant for thioamides. When the reaction was carried out in the presence of water only benzanilide (2) was formed



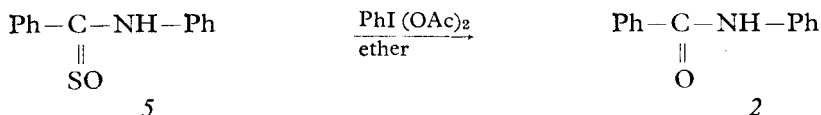
Whereas in the absence of water depending on the molar ratio bis(α -phenyliminobenzyl)sulphide (3) or a mixture of bis(α -phenyliminobenzyl)-sulphide (3) and bis(α -phenyliminobenzyl)disulphide (4) were obtained.

According to the views found in the literature, the formation of benzanilide (2) by the oxidation of thiobenzanilide may proceed either via thiobenzanilide-S-oxide⁷ (5) or via bis(α -phenyliminobenzyl)disulphide²⁴ (4).

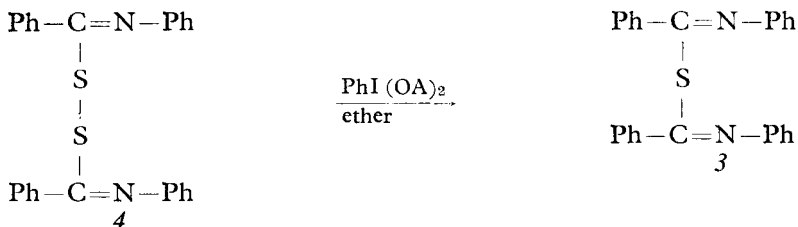
We have, therefore, studied the oxidation of these possible intermediates by phenyliodosodiacetate under the same reaction conditions as those employed



in the oxidation of thiobenzanilide (1) itself. It was found that thiobenzanilide-S-oxide (5) indeed gives benzanilide (2) when the reaction is carried out both in the presence and absence of water,



whereas bis(α -phenyliminobenzyl)disulphide (4) was oxidized by our agent only to bis(α -phenyliminobenzyl)sulphide (3) both in the presence and absence of water

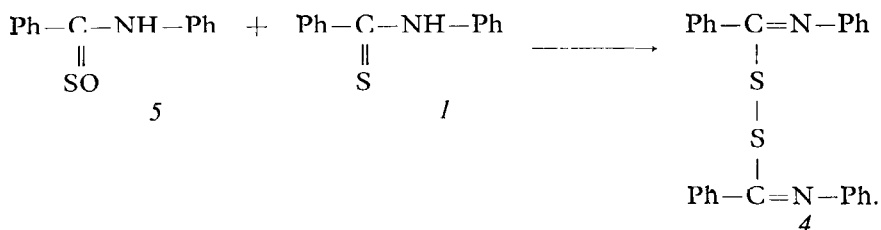


It could, thus, be concluded that bis(α -phenyliminobenzyl)disulphide (4) could be excluded as a possible intermediate in the formation of benzanilide (2) under our experimental conditions.

The given results show the possibility that thiobenzanilide-S-oxide (5) is an intermediary in the formation of benzanilide (2), although we were unable to isolate or identify it in any case.

Also we can accept thiobenzanilide-S-oxide (5) as an intermediary in the oxidation of thiobenzanilide (1) to bis(α -phenyliminobenzyl)disulphide (4) respectively bis(α -phenyliminobenzyl) sulphide (3). This can be concluded from the results in the reaction between thiobenzanilide-S-oxide (5) and thiobenzanilide (1). It was found out that the reaction takes place in the absence of water when bis(α -

phenyliminobenzyl)disulphide (4) is obtained, whereas in the presence of water no reaction takes place



EXPERIMENTAL

Oxidation of thiobenzanilide (1) with phenyliodosodiacetate in presence of water

In a solution of 2.13 g (0.01 M) of thiobenzanilide¹⁹ (1) in 300 ml of ether saturated with water 3.22 g (0.01 M) of phenyliodosodiacetate²² are added at once. The reaction mixture is stirred for one hour at room temperature. In order to remove the unreacted phenyliodosodiacetate 0.5 ml of ethylene glycol are added and the reaction mixture is evaporated to dryness in vacuo. The reaction product is easily and completely soluble in ethanol. From the ethanolic solution crystals of benzanilide (2) (1.59 g, 81%) were separated on cooling and were further purified by repeated recrystallization; m. p. 162–163°; Ref.²⁰ m. p. 162°. A sample mixed with authentic benzanilide (2) does not show depression of the m. p. and the i. r. spectrum of the product was identical with that of the authentic benzanilide (2).

The oxidation of thiobenzanilide (1) with phenyliodosodiacetate was carried out in an identical manner, but using molar ratios 2:1 and 4:1. In every case benzanilide (2) was isolated as the reaction product.

In the course of the oxidation, samples from the reaction mixture were removed and tested with iron(III) chloride²¹ on the presence of thiobenzanilide-S-oxide (5) the presence of which was never registered.

Oxidation of thiobenzanilide (1) with phenyliodosodiacetate in the molar ratio 1:1 in absence of water

To 300 ml of ether to which 1 ml of acetic acid anhydride or 2 g of anhydrous sodium carbonate have been added, 1.63 g (0.0075 M) of thiobenzanilide (1) and 2.42 g (0.0075M) of phenyliodosodiacetate are added. The reaction mixture is stirred for 1 h and then, in order to remove the unreacted phenyliodosodiacetate, 0.5 ml of ethylene glycol are added. The reaction mixture is evaporated to dryness in vacuo. The product is only slightly soluble in ethanol and is recrystallized from benzene from which, on cooling, crystals of bis(α-phenyliminobenzyl)sulphide(3) (1.2 g, 81%) were separated and were further recrystallized from benzene; m. p. 211–212°; Lit.¹⁶ m. p. 211°.

$\text{C}_{26}\text{H}_{20}\text{N}_2\text{S}$	calcd. %C 79.56	%H 5.14
(392.52)	found %C 79.30	%H 5.25

Oxidation of thiobenzanilide (1) with phenyliodosodiacetate in the molar ratio 2:1 or 4:1 in the absence of water

To 300 ml of ether to which 1 ml of acetic acid anhydride or 2 g of anhydrous sodium carbonate have been added, 1.63 g (0.0075 M) of thiobenzanilide (1) and 1.21 g (0.0037 M) of phenyliodosodiacetate are added. The reaction mixture is stirred for 1 h and then, in order to remove the unreacted phenyliodosodiacetate, 0.5 ml of ethylene glycol are added. The reaction mixture is evaporated to dryness in vacuo. The dry residue is treated with hot 96% ethanol which dissolves it partly. After the recrystallization of the undissolved part from benzene, 0.34 g (20%) of bis(α-phenyliminobenzyl)sulphide (3) (m. p. 211–212°) were obtained and identified as described above. From the hot alcoholic solution 0.4 g (25%) of the crystals separated on cooling. After recrystallization from ethanol yellow crystals of bis(α-phenyliminobenzyl)disulphide (4) were obtained having a m. p. of 103–104° (Lit.²³ m. p. 104–105°).

$C_{26}H_{20}N_2S_2$ (424.59)	calcd. %C 73.59 found %C 73.31	%H 4.72 %H 5.03
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The product was further identified by its infrared spectrum which was identical to that of an authentic sample.

The oxidation of thiobenzanilide (1) with phenyliodosodiacetate was also carried out, under identical conditions, using a molar ratio of 4:1. The oxidation of 1.6 g (0.0075 M) of thiobenzanilide (1) with 0.61 g (0.0018 M) of phenyliodosodiacetate resulted in the formation of 0.12 g (13.6%) of bis(α -phenyliminobenzyl)sulphide (3) and 0.8 g (50.3%) of bis(α -phenyliminobenzyl)disulphide (4).

Oxidation of thiobenzanilide-S-oxide (5) with phenyliodosodiacetate

Thiobenzanilide-S-oxide²³ (5) (1.14 g, 0.005 M) is dissolved in 100 ml of ether saturated with water. Phenyliodosodiacetate (1.65 g, 0.005 M) is added, the reaction mixture stirred for 1 h at room temperature and then, in order to remove the unreacted phenyliodosodiacetate, 0.5 ml of ethylene glycol are added. The reaction mixture is evaporated to dryness in vacuo. The reaction product is recrystallized from ethanol. Benzanilide (2) (0.8 g, 85%) is obtained; m.p. 161–162°.

The oxidation of thiobenzanilide-S-oxide (5) was also carried out in anhydrous ether (in the presence of acetic acid anhydride or anhydrous sodium carbonate) and again benzanilide (2) was obtained as the reaction product.

Oxidation of bis(α -phenyliminobenzyl)disulphide (4) with phenyliodosodiacetate

Bis (α -phenyliminobenzyl) disulphide (4) (1 g, 0.0025 M) is dissolved in 100 ml of ether saturated with water. Phenyliodosodiacetate (0.8 g, 0.0025 M) is then added and the reaction mixture is stirred one hour. After the addition of ethylene glycol the mixture is evaporated in vacuo to dryness. The reaction product is only slightly soluble in ethanol. It is recrystallized from benzene to obtain yellow crystals of bis(α -phenyliminobenzyl)sulphide (3) (8.3 g, 90%); m.p. 211–212°; Lit.¹⁶ m.p. 211°.

The oxidation reaction was carried out in anhydrous ether as well and again bis(α -phenyliminobenzyl)sulphide (3) was the reaction product.

Using the same procedure the oxidation of bis(α -phenyliminobenzyl)disulphide (4) was also attempted but it was found that the compound remained unchanged.

Reaction between thiobenzanilide-S-oxide (5) and thiobenzanilide (1)

To a solution of 0.57 g (0.0025 M) of thiobenzanilide-S-oxide (5) in 100 ml of dry ether (in the presence of Na_2CO_3) 0.53 g (0.0025 M) of thiobenzanilide (1) are added. The reaction mixture is stirred for 1 hour at room temperature and then the ether is evaporated, the product was recrystallized from ethanol and bis(α -phenyliminobenzyl)disulphide (4) (0.8 g, 75%) was obtained; m.p. 103–105°; Lit.²³ m.p. 104–105°.

ИЗВОД

ОКСИДАЦИЈА НА ТИОБЕНЗАНИЛИД СО ФЕНИЛЈОДОЗОДИАЦЕТАТ

БОЈАН Д. ПОДОЛЕШОВ и БОГДАН БОГДАНОВ

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Испитувана е реакцијата на оксидација на тиобензанилид со фенилјодозодацетат во етер. Утврдено е дека кога оксидацијата се одвива во отсуство на вода, во зависност од моларниот однос, како краен производ се добива бис(α -фенилиминобензил)сулфид или бис(α -фенилиминобензил)дисулфид, а во присуство на вода како краен производ се добива бензанилид. Испитувана е и реакцијата на оксидација на тиобензанилид-S-оксид со фенилјодозодацетат при истите услови и констатирано е дека како реакционен производ се добива бензанилид. Исто така испитувана е и реакцијата помеѓу тиобензанилид-S-оксид и тиобензанилид и утврдено е дека истата во отсуство на вода доведува до формирање на бис(α -фенилиминобензил)дисулфид, а при оксидација на така формиранит дисулфид се добива бис(α -фенилиминобензил)сулфид.

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REFERENCES

1. R. N. Hurd, G. DeLaMater, *Chem. Rev.*, **61**, 45 (1961)
2. K. A. Petrov, L. P. Andreev, *Usp. Khim.*, **40**, 1014 (1971)
3. F. Hodosan, *Acad. Rep. Populare Romine, Studii Cercetari Chim.*, **8**, 335 (1957); *C. A.* **53**, (1959) 18855c
4. M. S. A. El-Meligy, S. A. Mohamed, *J. Prakt. Chem.*, **316**, 154 (1974)
5. T. J. Jacob, C. G. Nair, *Talanta*, **13**, 154 (1966)
6. W. Walter, K. Wohlers, *Liebigs Ann. Chem.*, **752**, 115 (1971)
7. W. Walter, O. H. Bauer, *Ibid.*, 305 (1975)
8. T. Hisano, M. Ichikawa, *Chem. Pharm. Bull.*, **24**, 1451 (1976)
9. R. H. Thomson, *U. S. Nat. Tech. Inform., Serv., A. D. Rep.* (1972) No 75364; *C. A.* **78** (1973) 147859f.
10. H. Kunzek, G. Branikow, *Z. Chem.*, **13**, 175 (1973)
11. J. Liebscher, H. Hartmann, *Liebigs Ann. Chem.*, **1005** (1977)
12. J. Liebscher, H. Hartmann, *German (East) Patent* 1256306; *C. A.* **88** (1978) P 62393 f.
13. I. Shibuya, *Nippon Kagaku Kaishi*, 389 (1979); *C. A.* **90** (1979) 186869b.
14. H. Kunzek, E. Nesener, J. Voigt, *Z. Chem.*, **18**, 172 (1978)
15. P. H. Deshpande, *J. Indian Chem. Soc.*, **46**, 1096 (1969)
16. K. Heyns, W. Babenburg, *Chem. Ber.*, **89**, 1303 (1956)
17. M. Jančevska, V. Prisaganec, *God. Zb. Prir. Mat. Fak. Univ. Skopje, Mat. Fiz. Hem.* **21**, 59 (1971); *C. A.* **76** (1972) 140627d.
18. D. H. R. Barton, N. J. Cussans, S. V. Ley, *J. Chem. Soc. Chem. Comm.*, **9**, 393 (1978)
19. A. Bernthsen, *Chem. Ber.*, **11**, 503 (1978)
20. A. I. Vogel, „*A Text Book of Practical Organic Chemistry*“, 3rd edit., Longmans Green, London 1959, p. 559.
21. W. Walter, *Liebigs Ann. Chem.*, **633**, 35 (1960)
22. K. H. Pausaker, *J. Chem. Soc.*, 107 (1953)
23. W. Walter, J. Curts, H. Pawelzik, *Liebigs Ann. Chem.* **643**, 29 (1961)
24. H. Wojahn, E. Wenwoe, *Arch. Pharm.*, **285**, 375 (1952)
25. F. Hodosan, *Bull. Soc. Chim. France*, 633 (1957).