RESEARCHES ON 2, 1, 3-THIA- AND SELENADIAZOLE

XLVI. Behavior of 4- and 5-Hydroxy-2, 1, 3-Thiadiazoles and their Nitro Derivatives under the Bucherer Reaction Conditions*

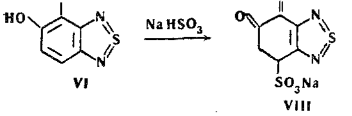
V. G. Pesin and I. A. Belen'kaya

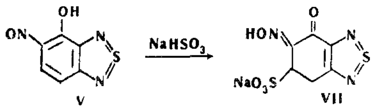
Khimiya Geterotsiklicheskikh Soedinenii, Vol. 3, No. 4, pp. 666–667, 1967

The Bucherer reaction converts 4- and 5-hydroxy-benz-2, 1, 3-thiadiazoles to 4- and 5-aminobenz-2, 1, 3-thiadiazoles, respectively. Reaction of 4-hydroxy-5-nitroso- and 5-hydroxy-4-nitrosobenz-2, 1, 3-thiadiazoles with sodium bisulfite gives 4-oxo-5-oxime-6-sulfo- (VII) and 5-oxo-4-oxime-7-sulfocyclohexa-2, 1, 3-thiadiazole (VIII). The phenylhydrazone and semicarbazone of VIII are also prepared. The IR spectra of compounds VII and VIII are determined.

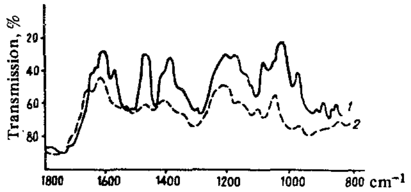
Amino derivatives of benz-2, 1, 3-thiadiazole undergo, like naphthylamines, the Bucherer reaction [7]. It appeared clear that hydroxy derivatives of benz-2, 1, 3-thiadiazole and their nitro substitution derivatives should undergo this reaction to give the corresponding amines. As with naphthols [2, 6], the intermediates should be bisulfite addition compounds of hydroxy derivatives of benz-2,1,3-thiadiazole, i. e., the corresponding ketosulfo acids of cyclohexa-2,1,3-thiadiazole. This conclusion is in agreement with the statement in the literature [8] that, for example, 5-hydroxy-4-nitrobenz-2, 1, 3-thiadiazole (VI) cannot be made to react with sodium bisulfite. Meanwhile the question of the capacity of hydroxy derivatives of benz-2, 1, 3-thiadiazole to undergo the Bucherer reaction, and hence to react with sodium bisulfite, is mainly of theoretical interest.

The present research dealt with the conversion of 4- (I) and 5-hydroxy-2, 1, 3-thiadiazole (II) to, respectively, 4- (III) and 5-aminobenz-2, 1, 3-thiadiazole (IV) under the conditions of the Bucherer reaction, and the structures of the reaction products from sodium bisulfite and 4-nitro derivative II (VI), and 5-nitro derivative I (V). Under the Bucherer reaction conditions, compounds III and IV were obtained in 30% and 90% yield, respectively. With sodium bisulfite compound VI gives 4-oximino-5-keto-7-sulfocyclohexa-2, 1, 3-thiadiazol (VIII) and, similarly, V gives 5-oximino-4-keto-6-sulfocyclohexa-2, 1, 3-thiadiazole (VII).





The presence of the keto group in VIII is shown by formation of the phenylhydrazone (IX) and semicarbazone X.* IR spectroscopic data (IKS-14 instrument; vaseline mulls) proved VII and VIII to be ketosulfo acids. VII exhibits a marked keto band at 1623 cm^{-1}.



IR spectra of compounds VII (1) and VIII (2)

The sulfo group of this compound absorbs in the 1045 and 1226 cm^{-1} regions; its oxime group in the 965 and 1660 cm^{-1} regions. The characteristic frequencies of the keto, sulfo, and oxime groups in the spectrum of VIII agree with the corresponding frequencies in the spectrum of VII; 1627cm^{-1} (keto group), 1027 and 1227 cm^{-1} (sulfo group), 1645 and 967 cm^{-1} (oxime group). A similar spectrum is given by derivatives of isomeric tetralonesulfonic acids [5], which can be explained by the structural similarity between naphthalene and benz-2, 1, 3-thiadiazole.

EXPERIMENTAL

4-Aminobenz-2, 1, 3-thiadiazole (III). A mixture of 0.5 g (3.3 mM) I [7, 9] 3 g freshly prepared moist ammonium sulfite, and 25 ml ammonia (d 0.9) was heated for 30 hr at 120°–130° C in a sealed tube. After cooling the contents of the tube were made alkaline with 25 ml 20% NaOH and extracted with $CHCl_3$. Yield 0.12 g (24%), mp 67° C (ex EtOH), undepressed mixed mp with compound III prepared as described in [11]. After extracting with $CHCl_3$ the aqueous layer was acidified with HCl, and 0.1 g I extracted with $CHCl_3$.

5-Aminobenz-2, 1, 3-thiadiazole (IV). Prepared from II [7] similarly to III, yield 90%; mp 114°–116° C (ex EtOH), undepressed mixed mp with IV prepared as described in [11].

Na salt of 4-oximino-5-keto-7-sulfohexa-2, 1, 3-thiadiazole (VIII). A mixture of 5 g (27.7 mM) VI [10], 20 ml Na bisulfite (d 1.205) 40 ml water, and 30 drops of pyridine were kept for 48 hr at room temperature, filtered 13 g NaCl added to the filtrate, the solid filtered off, washed with EtOH, and then with ether. Yield 1.52 (15.5%) compound, readily soluble in water and 10% NaOH. At 110°–115° C VIII loses 4 moles water of crystallization. Recrystallized from 80% ethanol. Found: N 12.22; 12.15; S 17.60; 17.77%, calculated for $C_6H_3N_3NaO_5S_2 \cdot 4H_2O$: N 11.80; S 17.95%.

---

*For Part XLV see [1]

*Similar derivatives of VII were not obtained due to the restricted accessibility of the latter.

Na salt of 5-oximino-4-keto-6-sulfocyclohexa-2, 1, 3-thiadiazole (VII). A mixture of 0.5 g (2.77 mM) V [10], 1 ml Na bisulfite, and 3 drops of pyridine were heated together for 8 hr at 50°–60° C and filtered when hot to remove resinous material, which was washed with 5 ml water. 1.3 g NaCl was added to the hot filtrate, and the whole cooled to 10°. The precipitate was filtered off and washed with EtOH, then ether. Yield 0.12 g (10.2%) compound, readily soluble in water and 10% NaOH. At 110°–115° C it loses 8 moles of water of crystallization, and was recrystallized from 80% EtOH. Found: N 9.84; 9.99; S 14.59; 14.45%, calculated for $C_6H_3N_3NaO_5S_2 \cdot 8H_2O$: N 9.81; S 14.92%.

VIII phenylhydrazone-5 (IX). A solution of 1.2 g crystalline NaOAc in 3 ml water was added to a mixture of 1.05 g (2.95 mM) VIII, 18 ml water, and 0.6 g phenylhydrazine hydrochloride. After 3 days the precipitate was filtered off, then washed with EtOH and ether. Yield 0.12 g (9.9%), contained 2 moles water of crystallization, which it lost at 110°–115° C. Recrystallized from 50% EtOH. Found: N 17.22; 17.35; S 15.82; 15.65%, calculated for $C_{12}H_9N_5NaO_4S_2 \cdot 2H_2O$: N 17.05; S 15.60%.

VIII semicarbazone (X). 0.9 g crystalline NaOAc in 4.5 ml water was added to a mixture of 1.05 g (2.95 mM) VIII, 18 ml water, and 0.6 g semicarbazide hydrochloride in 45 ml water. After 5 days the solid was filtered off, then washed with EtOH and ether. Yield 0.33 g (22.2%), contained 9 mole water of crystallization, which it lost at 110°–115° C. Recrystallized from 50% EtOH. Found: N 16.29; 16.80; S 12.40; 12.42%, calculated for $C_7H_6N_6NaO_5S_2 \cdot 9H_2O$: N 16.69, S 12.70%.

REFERENCES

1. V. G. Pesin and I. A. Belenkaya, KhGS [Chemistry of Heterocyclic Compounds], 289, 1967.
2. S. V. Bogdanov, Khim. nauka i prom., **2**, 134, 1957.
3. S. V. Bogdanov and N. I. Karandasheva, ZhOKh, **26**, 3365, 1956.
4. S. V. Bogdanov, ZhOKh, **28**, 1324, 1328, 1958.
5. A. Rieche and H. Seeboth, Lieb. Ann. Chem., **638**, 43, 57, 66, 76, 101, 1960.
6. H. Seeboth, Monatsber. Dtsch. Acad. Wiss., Berlin, **3**, 1, 43, 1961.
7. V. G. Pesin, A. M. Khaletskii, and I. A. Lotsmanenko, ZhOKh, **33**, 1746, 1963.
8. L. S. Efros, R. P. Polyakova, and M. G. Argitti, ZhOKh, **32**, 516, 1962.
9. V. G. Pesin, A. M. Khaletskii, and I. A. Lotsmanenko, Author's Certificate 145243, Byull. izobr., no. 5, 1962.
10. V. G. Pesin, I. A. Belen'kaya-Lotsmanenko, and A. M. Khaletskii, ZhOKh, **34**, 3763, 1964.
11. V. G. Pesin and A. M. Khaletskii, ZhOKh, **28**, 20, 1958.

9 December 1965