o-Nitrophenyl acetate is not attacked by boiling water and is slightly volatile with steam.

CHEMICAL LABORATORY OF THE ADMIRALTY
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2-Amino-5-thiazolesulfonic Acid Derivatives

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For the purpose of bacteriological studies several 2-amino-5-thiazolesulfonic acid derivatives have been made.[1] The intermediate compound used in synthesizing these derivatives was 2-acetamino-5-thiazolesulfonyl chloride, made in 15 to 25% yield by the action of chlorosulfonic acid on 2-acetaminothiazole. The sulfonyl chloride reacted smoothly with several amines in pyridine to form the corresponding 2-acetamino-5-thiazolesulfonamides which were deacetylated by acid hydrolysis. When stirred with sodium sulfite solution, 2-acetamino-5-thiazolesulfonyl chloride was reduced to 2-acetamino-5-mercaptothiazole (VI).

TABLE I

2-AMINO-5-THIAZOLESULFONIC ACID DERIVATIVES

Compound	Name	Decompn. p., °C. (uncor.)	Yield,[a] %	Analytical data,[b] % Calcd. C	Calcd. H	Calcd. N	Found C	Found H	Found N
I	2-Acetamino-5-thiazolesulfonamide	273	52.5	27.12	3.19	18.98	27.12	3.18	18.93
II	2-(2-Amino-5-thiazolesulfonamido)-pyridine	228	65	37.57	3.14	21.86	37.61	3.11	22.13
III	2-(2-Amino-5-thiazolesulfonamido)-pyrimidine	253	39	32.68	2.74	27.22	32.80	2.73	27.29
IV	2-(2-Amino-5-thiazolesulfonamido)-thiazole	235	45	27.47	2.30	21.36	27.37	2.23	21.15
V	*p*-(2-Amino-5-thiazolesulfonamido)-aniline[c]	196	57	39.99	3.73	20.73	39.88	3.81	20.66
VI	2-Acetamino-5-mercaptothiazole	203	73.5	34.46	3.47	16.08	34.37	3.09	15.98

[a] Based on the amount of 2-acetamino-5-thiazolesulfonyl chloride employed. [b] The micro-analyses were performed by Dr. Carl Tiedcke. [c] The intermediate amine used was *p*-aminoacetanilide.

Experimental

2-Amino-5-thiazolesulfonic Acid Derivatives

2-Acetamino-5-thiazolesulfonyl Chloride.—A 15-g. (0.106 mole) portion of 2-acetaminothiazole[2] was heated with 61 g. (0.53 mole) of chlorosulfonic acid at 100° for two hours and fifteen minutes.[3] Then the solution was poured onto 560 g. of ice causing a precipitate to form. The precipitate was filtered off, washed with ice water and dried over sodium hydroxide at reduced pressure. The product weighed 6.2 g. and was used in subsequent reactions without further purification. It decomposed at 220° when inserted in a bath at 200° and decomposed at the same point after crystallizing from acetone. A positive test for chlorine and elemental analyses of the amide derived from the compound indicated that the compound was a 2-acetaminothiazolesulfonyl chloride. Several thiazole studies[4,5,6] have given evidence that the hydrogen in position 5 of a compound like 2-acetaminothiazole would be more active than the one in position 4. This evidence indicated that the sulfonyl chloride was probably in position 5 on the thiazole nucleus.

2-Acetamino-5-thiazolesulfonamide (I).—This derivative was prepared from 5.39 g. of 2-acetamino-5-thiazolesulfonyl chloride in acetone by introducing ammonia with cooling. A yield of 2.6 g. of 2-acetamino-5-thiazolesulfonamide (I) was obtained after crystallizing from dilute ethanol. The sulfonamide group of this compound hydrolyzed rapidly to the sulfonic acid group in the presence of hydrochloric acid or in a solution of hydrogen chloride in 95% ethanol at various concentrations. No conditions were found for selectively hydrolyzing the acetyl group without affecting the sulfonamide portion. No 2-amino-5-thiazolesulfonamide was isolated under conditions of partial hydrolysis of 2-acetamino-5-thiazolesulfonamide.[7]

2-Amino-5-thiazolesulfonamides.—The N^5 substituted sulfonamides (II, III, IV and V) were readily made by heating 2-acetamino-5-thiazolesulfonyl chloride at 60° for one and one-half hours with the appropriate amine in dry pyridine. The pyridine solution was then diluted with water, neutralized with dilute sodium hydroxide and vacuum distilled. The residual acetamino derivative was dissolved in dilute sodium hydroxide solution to remove any alkali-insoluble material, and was then heated with 10% hydrochloric acid to remove the acetyl group. 2-(2-Acetamino-5-sulfonamido)-thiazole (IV) became dark and produced a sulfide odor when subjected to a hydrolysis in hot 2.5 *N* sodium hydroxide. The 2-amino-5-thiazolesulfonamides were purified by crystallization from dilute ethanol.

2-Acetamino-5-mercaptothiazole (VI).—By the procedure used in reducing *p*-acetaminobenzenesulfonyl chloride to *p*-acetaminobenzenesulfinic acid with sodium sulfite,[8] a 73.5% yield of 2-acetamino-5-mercaptothiazole was obtained from 2-acetamino-5-thiazolesulfonyl chloride. Evidently any 2-acetamino-5-thiazolesulfinic acid formed was reduced immediately to the mercapto derivative. Zinc dust in 95% ethanol at 10° also accomplished this reduction. The compound was soluble in dilute potassium hydroxide and was purified by crystallizing from hot water.

(1) After this work was completed Backer and Buisman published on a similar work which included a description of compounds I, II and IV, *Rec. trav. chim.*, **63**, 228 (1944); *C. A.*, **40**, 2446 (1946).

(2) Jensen and Thornsteinsson, *Dansk Tids. Farm.*, **15**, 41 (1941); *C. A.*, **35**, 5109 (1941).

(3) Heating sodium 2-acetamino-5-thiazolesulfonate with chlorosulfonic acid or with phosphorus pentachloride was not as satisfactory a method of producing the sulfonyl chloride.

(4) Ochiai and Nagazawa, *Ber.*, **72**, 1470 (1939).

(5) Backer and Buisman, *Rec. trav. chim.*, **63**, 226 (1944); *C. A.*, **40**, 2446 (1946).

(6) Erlenmeyer and Kiefer, *Helv. Chim. Acta*, **28**, 985 (1945); *C. A.*, **40**, 1500 (1946).

(7) Since this work was done, Backer and Buisman reported obtaining 2-amino-5-thiazolesulfonamide, *Rec. trav. chim.*, **63**, 228 (1944).

(8) "Organic Syntheses," Coll. Vol. I, p. 7.

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Strength of Aqueous Thiocyanic Acid

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In the course of some work on the thiocyanates it became necessary to know the strength of

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