gives rise to at least eight different products when held at high temperatures for extended periods.[9]

The presence of at least one epoxide group in IX was shown by its reduction to a diol (XIV) with lithium aluminum hydride; acetylation of XIV by acetic anhydride in pyridine indicated that the reduced epoxide was attached at one end to a tertiary carbon atom as only one of the hydroxyl groups in XIV (presumably the one at 3β) was esterified.

EXPERIMENTAL[10]

Pyrolysis of 9(11)dehydroergosterol peroxide acetate (VI). A. Under a stream of nitrogen, 20 g. of 9(11)dehydroergosterol peroxide acetate[11] was refluxed in 125 ml. of *n*-dodecane for 75 min., then allowed to stand in the refrigerator overnight. Filtration afforded 3.25 g. of *IX*, m.p. 187–195°. A portion of this material (630 mg.) was placed on 15 g. of alumina and eluted with 19:1 benzene-hexane. After recrystallization from methanol, the analytical sample of IX was obtained as plates, m.p. 192–195°; $[\alpha]_D$ +243° (*c* 1.41).

Anal. Calcd. for $C_{30}H_{44}O_4$: C, 76.88; H, 9.46; mol. wt., 468. Found: C, 76.70; H, 9.61; mol. wt., 473 (micro-Rast in camphor).

Saponification of IX was effected by refluxing a solution of 100 mg. of the steroid acetate in a mixture of 0.3 g. of potassium hydroxide, 0.5 cc. of water, and 20 cc. of methanol for 90 min. Water was added to incipient precipitation and cooling gave 72 mg. of a solid (XI), which was recrystallized from aqueous methanol, m.p. 172–175°; $[\alpha]_D$ +274° (*c* 1.04).

Anal. Calcd. for $C_{28}H_{42}O_3$: C, 78.82; H, 9.92. Found: C, 78.75; H, 10.14.

B. In a similar manner 1.0 g. of VI was refluxed 1 hr. in *n*-dodecane under nitrogen. After standing overnight, the solid IX (162 mg., 16%) was removed and the filtrate placed on 30 g. of alumina. Elution with 19:1 hexane-benzene yielded 228 mg. (24%) of 9(11)dehydroergosterol acetate (X), which after recrystallization from methanol melted at 148.5–151°; λ_{max} 310 (ϵ 10,000), 324 (ϵ 11,600), and 339 mμ (ϵ 7300); lit.[12]: m.p. 147.5–149.5°; λ_{max} 311 (ϵ 10,500), 324 (ϵ 12,100) and 341 mμ (ϵ 7500). Further elution of the column produced mixtures.

3β-Acetoxyergosta-9(11),22-diene-5,6α-epoxy-7-one (VII). The final filtrate from part A in the pyrolysis of VI was placed on 300 g. of Florisil and all the 9(11) dehydroergosterol acetate (X) present was removed by elution with 99:1 hexane-acetone. Elution with 49:1 hexane-acetone then gave 325 mg. (1.6%) of VII, m.p. 146.5–149°, which was obtained as small needles after recrystallization twice from methanol, m.p. 149.5–150.5°; $[\alpha]_D$ +29.6° (*c* 1.149).

Anal. Calcd. for $C_{30}H_{44}O_4$: C, 76.88; H, 9.46. Found: C, 76.22; H, 9.65.

3β-Acetoxyergosta-8,22-diene-5,6α-epoxy-7-one (IV). A benzene solution of 50 mg. of VII was placed on 5 g. of unneutralized alumina. After 2 hr. the steroid was eluted with ether and recrystallized from methanol to give material, m.p. 196.5–205°, whose infrared spectrum was identical with that of 3β-acetoxyergosta-8,22-diene-5,6α-epoxy-7-one (IV); lit.[4]: m.p. 209–210°.

Reduction of IX. To a slurry of 1.2 g. of lithium aluminum hydride in 50 cc. of ether there was added 500 mg. of IX. After standing 4 hr. at room temperature, a saturated aqueous solution of ammonium chloride was carefully added. The ethereal layer was separated and the aqueous portion extracted with chloroform. The organic material was combined, dried, and evaporated giving 395 mg. of XIV which on recrystallization from acetone melted at 206–210° dec.; $[\alpha]_D$ +211° (*c* 1.04). Satisfactory elemental analyzes for XIV were not obtained.

One hundred milligrams of XIV was treated overnight with acetic anhydride in pyridine. Workup in the usual manner gave 63 mg. of a solid which was recrystallized from methanol-chloroform and obtained as platelets, m.p. 245.5–248.5°; $[\alpha]_D$ +210° (*c* 1.12); λ_{max}^{KBr} 2.93, 5.75, 5.89, 6.02 μ.

Anal. Calcd. for $C_{30}H_{44}O_4$: C, 76.88; H, 9.46. Found: C, 76.71; H, 9.20.

Reaction of IX *with acid.* To a solution of 100 mg. of IX in 20 cc. of dioxane, there was added a solution of 100 mg. of *p*-toluenesulfonic acid in 2 cc. of water and 3 cc. of dioxane. After standing 18 hr. at room temperature, the reaction mixture was poured into water and extracted with chloroform. The extracts were washed, dried, and evaporated to yield 85 mg. of an oil, which was obtained as an amorphous solid from hexane, m.p. 161–163°; λ_{max}^{KBr} 2.93, 5.74, 5.79 (shoulder), 5.93 μ.

STERLING CHEMISTRY LABORATORY
YALE UNIVERSITY
NEW HAVEN, CONN.

---

[9] E. Rick, Ph.D. dissertation, Yale University (1959).

[10] All melting points are corrected. Rotations were measured in chloroform at 25° in a 1 decimeter tube using a photoelectric polarimeter. Infrared spectra were determined in potassium bromide windows. The ultraviolet spectra were determined in absolute alcohol.

[11] A. Windaus and O. Linsert, *Ann.*, **465**, 157 (1928).

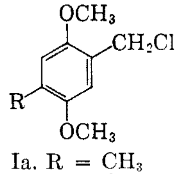
[12] R. Antonucci, S. Bernstein, D. Giancola, and K. J. Sax, *J. Org. Chem.*, **16**, 1159 (1951).

The Synthesis of 2-Chloromethyl-5-alkylhydroquinone Dimethyl Ethers by a Controlled Chloromethylation

GREGORY J. LESTINA AND HOMER W. J. CRESSMAN

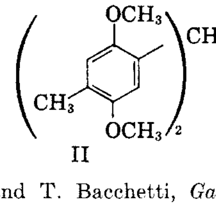
Received February 24, 1960

During the course of our work some hydroquinone dimethyl ethers of Types Ia and Ib were needed.



Ia. R = CH_3
Ib. R = C_8H_{17}

Neither compound had been reported in the literature and a convenient preparation of this class of compounds was not apparent. In fact, an attempt to prepare Ia by the chloromethylation of 2,5-dimethoxytoluene[1] had yielded only 5,5′-methylenebis(toluhydroquinone dimethyl ether) (II).



II

---

[1] G. Jacini and T. Bacchetti, *Gazz. chim. ital.*, **80**, 760 (1950).

However, it appeared likely that Ia had been formed as a precursor to II and our experience with the chloromethylation reaction led us to believe that Ia could be obtained in good yield by properly adjusting the reaction conditions.

When 2,5-dimethoxytoluene was slowly added to a chloromethylation mixture at 55–60°, yields of Ia from 55–65% were obtained. This mode of addition of reagent differs from those generally applied[2] in which either all reactants are mixed at once or formalin is added slowly to the reaction mixture.[1] The position of the chloromethyl group was shown by converting Ia to the known 2,5-dimethoxy-*p*-xylene (III).[3]

This technique of chloromethylation, when applied to *n*-octylhydroquinone dimethyl ether gave Ib in comparably good yield, and it is reasonable to assume that other alkyl- or aryl-substituted hydroquinone dimethyl ethers can be chloromethylated with similar ease.

EXPERIMENTAL[4]

5-Chloromethyltoluhydroquinone dimethyl ether (Ia). Gaseous hydrogen chloride was bubbled into a well-stirred mixture of 200 ml. of 35% formaldehyde, 100 ml. of concd. hydrochloric acid, and 400 ml. of dioxane for 15 min. at such a rate that the temperature of the mixture remained between 55–60° with no external heating. To this mixture 152 g. (1.0 mole) of 2,5-dimethoxytoluene was added, dropwise, over a period of 20 min., while the temperature was maintained between 55–60°. When the addition was completed, the passage of hydrogen chloride was stopped. The mixture was cooled and poured into 2 l. of ice water and 300 ml. of ethyl ether. The aqueous layer was extracted twice more with 250-ml. portions of ether. The combined ether extracts were washed with cold water until the washings were neutral to litmus, then dried with anhydrous magnesium sulfate, and evaporated under reduced pressure. The residue was distilled through a 4-in. Vigreux column to give 110–130 g. (55–65%) of colorless liquid, b.p. 144–153°/14–16 mm., which solidified on cooling. Recrystallization from acetonitrile gave white crystals, m.p. 61.5–62.5°.

Anal. Calcd. for $C_{10}H_{13}ClO_2$: C, 59.9; H, 6.5; Cl, 17.7. Found: C, 59.8; H, 6.5; Cl, 17.5.

A portion of the residue from the distillation flask was recrystallized from 95% ethanol to give II, m.p. 147–148°.[1]

2,5-Dimethoxy-p-xylene (III). A mixture of 1.0 g. of Ia in 150 ml. of ethyl acetate containing 1.0 g. of 10% palladium on charcoal catalyst was hydrogenated at 45 p.s.i. and 25°. After 1 hr., the mixture was filtered to remove the catalyst and the filtrate evaporated to give a white solid which, after recrystallization from hexane, gave 0.5 g. of white crystals, m.p. 108–109° (lit.[3] m.p. 108°). A mixed melting point with authentic III was not depressed and the infrared spectra of the two were identical.

5-n-Octylhydroquinone dimethyl ether. To a mixture of 2 g. of 10% palladium on charcoal catalyst in 150 ml. of acetic acid was added 26.4 g. (0.1 mole) of 2-*n*-caprylyhydroquinone dimethyl ether.[5] The mixture was hydrogenated at 50 p.s.i. at 25° and hydrogenation was complete overnight. The catalyst was filtered and the acetic acid removed under reduced pressure. The residue was distilled to give 21.3 g. (85%) of slightly yellow liquid, b.p. 128–132°/1 mm., n_D^{25} 1.4979.

Anal. Calcd. for $C_{16}H_{26}O_2$: C, 76.8; H, 10.4. Found: C, 76.5; H, 10.3.

2-Chloromethyl-5-n-octylhydroquinone dimethyl ether (Ib). The reaction was performed exactly as described for the preparation of Ia. From 100 g. (0.4 mole) of *n*-octylhydroquinone dimethyl ether there was obtained, after distillation, 75 g. (62%) of colorless liquid, b.p. 170–173°/0.4 mm., which solidified on cooling. Recrystallization from acetonitrile gave white crystals, m.p. 51–52°.

Anal. Calcd. for $C_{17}H_{27}ClO_2$: C, 68.3; H, 9.1; Cl, 11.9. Found: C, 68.5; H, 9.0; Cl, 11.8.

KODAK RESEARCH LABORATORIES
ROCHESTER 4, N. Y.

---

[2] R. C. Fuson and C. H. McKeever, *Org. Reactions*, **Vol. I**, 63 (1942).

[3] E. Noelting and P. Werner, *Ber.*, **23**, 3251 (1890).

[4] All melting points were measured in capillary tubes and are uncorrected.

[5] J. H. Cruickshank and R. Robinson, *J. Chem. Soc.*, 2064 (1938).

2-Aminothiazolesulfonamides

CARL ZIEGLER, ELEANOR K. KUHL,
AND JAMES M. SPRAGUE

Received November 5, 1959

The sulfonation of 2-acetamidothiazoles with chlorosulfonic acid has been reported by several investigators, but the structure of the resulting sulfonyl chlorides has been a subject of controversy.[1–3]

Backer and co-workers[4,5] considered the products that they obtained from 2-acetamidothiazole and 2-acetamido-4-methylthiazole to be 5-sulfonyl chlorides (I). This assignment of structure by these investigators was based on previous work which proved the point of attack of electrophilic agents, such as nitric acid and bromine, to be the 5 position of the thiazole ring.

However, Postovskii and Belaya,[3] who carried out the reaction under similar conditions, interpreted the reaction as occurring on the acetamido group to yield the acetylsulfamyl chlorides (II). Postovskii[6] later concluded, on the basis of infrared absorption spectra, that this interpretation was in error and that the products were thiazole-5-sulfonyl chlorides.

The amides derived from these sulfonyl chlorides afford a ready solution to the problem. Hydrolysis of the acetyl derivatives that arise from the reaction

---

[1] H. E. Faith, *J. Am. Chem. Soc.*, **74**, 5799 (1952); **69**, 2063 (1947).

[2] C. D. Hurd and H. L. Wehrmeister, *J. Am. Chem. Soc.*, **71**, 4008 (1949).

[3] I. Ya. Postovskii and T. S. Belaya, *Compt. Rend. Acad. Sci. U.R.S.S.* **40**, 326 (1943); *Chem. Abstr.* **39**, 1151 (1945).

[4] H. J. Backer and J. de Jonge, *Rec. trav. chim.*, **62**, 158 (1943).

[5] H. J. Backer and J. A. K. Buisman, *Rec. trav. chim.*, **63**, 228 (1944).

[6] I. Ya. Postovskii and T. S. Mamykina, *Zhur. Obshchei Khim.* **23**, 1765 (1953); *Chem. Abstr.* **49**, 300 (1955); S. G. Bogomolov, Yu. N. Sheinker and I. Ya. Postovskii, *Zhur. Obshchei Khim.*, **24**, 539 (1954); *Chem. Abstr.* **48**, 8654 (1954).