

2,3,6-trimethyl glucose, and 2,3,4,6-tetramethyl glucose. Mertzweiller, Carney and Farley³ separated a synthetic mixture of the pure sugars by conversion to their colored azoyl esters and adsorption on a silica column. Jones⁴ hydrolyzed methylated starch with methyl-alcoholic hydrogen chloride to give the tri- and tetramethyl methyl glucosides, which were adsorbed on an alumina column. By analysis of successive portions of the eluate, he showed that these glucosides could be quantitatively eluted in separate fractions.

This laboratory has applied the chromatographic method directly to the methyl glucoses. It was found that ultraviolet light can be used to facilitate the development of such chromatograms, since it permits following visually the separation of the fluorescent glucoses.

When a solution of tri- and tetramethyl glucose in benzene is passed through an alumina column, a single fluorescent band is formed which, upon further development with benzene separates into two bands, the lower being tetramethyl glucose. After forcing the adsorbent out of the tube, the respective bands may be cut from the column and the sugars extracted with methanol. Evaporation of the methanol solution has given a quantitative recovery (95-105%) of the tri- and tetramethyl glucoses.

Since dimethyl glucose is not soluble in benzene, it was separated as follows: A solution of di-, tri- and tetramethyl glucose in acetone-benzene (1:1) was passed through an alumina column and developed with benzene. The dimethyl glucose was adsorbed as a fluorescent band, while the other two sugars passed through unadsorbed. They were recovered by evaporation of the solvent, redissolved in benzene, and separated as described above. The separation of dimethyl glucose from the tri- and tetramethyl glucoses has as yet been carried out only on a qualitative basis, since it was necessary to discontinue the work temporarily.

Experimental

Fibrous alumina was prepared and activated according to the Wislicenus method.⁵ It is only faintly fluorescent, while all available commercial alumina preparations proved to be highly fluorescent. The adsorption tubes were 7-inch lengths of 8-mm. Pyrex tubing. A mercury vapor lamp with suitable filter provided a source of ultraviolet light. Since the columns were packed and developed under a constant air pressure (25 cm.), a convenient apparatus for adding the solutions without interrupting the pressure was devised.

In most cases, the following procedure was found satisfactory. The fibrous alumina was made into a thick slurry with benzene and poured into the adsorption tube containing a cotton plug at the bottom. The column was packed by application of pressure to give a 10-cm. length of adsorbent, care being taken not to let it become free of solvent at any time. About 20-50 mg. of the mixed tri- and tetramethyl glucoses, dissolved in 5-10 ml. of warm

benzene and cooled, was passed through the column. Development with benzene was then begun and continued until the desired separation of bands was obtained. The tube was occasionally moved to a dark box for observation of the fluorescent bands under ultraviolet light. The recovered methyl glucoses were identified by their methoxyl contents and melting points.

The 2,3-dimethyl glucose used in these experiments was obtained through the courtesy of Drs. Coleman and McCloskey at the State University of Iowa.

PLANT CHEMISTRY SUBSECTION

IOWA AGRICULTURAL EXPERIMENT STATION

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Aryl Sulfides and Sulfones Containing the Diethylaminoethyl Group

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Several aryl sulfides and sulfones containing the 4- β -diethylaminoethylamino group have been prepared for the purpose of testing their activity against certain organisms. It has been found that they have only a slight bacteriostatic action *in vitro* against *Staph. aureus*. Similar tests against various intestinal bacilli demonstrated that 4-(β -diethylaminoethylamino)-phenyl 4-nitrophenyl sulfone has definite antibacterial activity toward several members of this group.² However, *in vivo* tests showed the compound to be quite toxic to mice.

Experimental

4-(β -Diethylaminoethylamino)-phenyl 4-Nitrophenyl Sulfide (I).—Forty-six grams of β -diethylaminoethyl chloride and 75 g. of 4-nitrophenyl 4-aminophenyl sulfide³ were heated with stirring in 150 ml. of nitrobenzene at 120-130° for six hours. The nitrobenzene was removed by steam distillation and the residue was treated with a small amount of ether. On stirring, a solid separated which was filtered off; the yield was 32 g. (30%). Several recrystallizations from alcohol gave yellow plates melting at 89°.

Anal. Calcd. for $C_{18}H_{22}N_2O_2S$: N, 12.17. Found: N, 12.28.

4-(β -Diethylaminoethylamino)-phenyl 4-Nitrophenyl Sulfide Dihydrochloride.—Alcoholic hydrogen chloride was added to a solution of the base (I) in acetone. Addition of dry ether caused precipitation of the dihydrochloride. It was recrystallized several times from acetone-ether. A light yellow powder was obtained melting at 140-142°.

Anal. Calcd. for $C_{18}H_{24}N_2O_2Cl_2S$: N, 10.05; Cl, 17.0. Found: N, 10.18; Cl, 16.6.

4-(β -Diethylaminoethylamino)-phenyl 4-Aminophenyl Sulfide.—Thirty-two grams of the base (I) was refluxed for three hours in a well-stirred suspension of 120 g. of iron filings in 540 ml. of 50% alcohol containing 3 ml. of acetic acid. The hot reaction mixture was made alkaline with sodium carbonate and filtered. The alcohol was distilled from the colorless filtrate under reduced pressure and the residue was extracted with ether. After removing the ether, the amine was distilled; yield, 7.5 g.; b. p. 234° (1 mm.).

Anal. Calcd. $C_{18}H_{24}N_2S$: N, 13.33. Found: N, 13.33.

(1) Present address: Vick Chemical Co., New York, N. Y.

(2) Our thanks are due to Dr. C. A. Lawrence and G. R. Goetchius for this report.

(3) Gabel and Grinberg, *C. A.*, **34**, 6244 (1940).

(3) Mertzweiller, Carney and Farley, *THIS JOURNAL*, **65**, 2367 (1943).

(4) Jones, *J. Chem. Soc.*, 333 (1944).

(5) As described in Strain's "Chromatographic Adsorption Analysis," Interscience Publishers, New York, N. Y., 1942, p. 54.

4-(β -Diethylaminoethylamino)-phenyl 4-Nitrophenyl Sulfoxide Hydrochloride.—A solution of 3 g. of the base (I) in 50 ml. of glacial acetic acid and 1.5 ml. of 30% hydrogen peroxide was allowed to stand for twenty-four hours and was then heated on a steam-bath for thirty minutes. The reaction mixture was made alkaline with sodium hydroxide and extracted with ether. After drying and removing the ether, the residual oil was dissolved in absolute alcohol and treated with alcoholic hydrogen chloride; dry ether was then added to turbidity. On standing in the refrigerator an orange powder separated; yield, 1.7 g. After several recrystallizations from alcohol-ether, a product melting at 157–159° was obtained.

Anal. Calcd. for $C_{15}H_{24}N_3O_3S$: N, 10.56; Cl, 8.93. Found: N, 10.58, 10.34; Cl, 8.90, 9.06.

4-(β -Diethylaminoethylamino)-phenyl 4-Nitrophenyl Sulfone (II).—Sixty grams of β -diethylaminoethyl chloride and 28 g. of 4-nitrophenyl 4-aminophenyl sulfone was heated with stirring in 150 ml. of nitrobenzene at 120–130° for eight hours. The nitrobenzene was removed by steam distillation and the residue was made alkaline with sodium hydroxide and extracted with ether. The ether was dried and removed by distillation. The thick oily residue solidified on standing; yield 13.5 g. (35%). After several recrystallizations from alcohol, the sulfone was obtained in the form of light-yellow needles melting at 109°.

Anal. Calcd. for $C_{15}H_{22}N_2O_2S$: N, 11.14. Found: N, 11.18.

4-(β -Diethylaminoethylamino)-phenyl 4-Nitrophenyl Sulfone Hydrochloride.—A solution of II in ether was treated with alcoholic hydrogen chloride. The yellow solid which precipitated was recrystallized from absolute alcohol giving a product which melted at 190–192°.

Anal. Calcd. for $C_{15}H_{24}N_3O_2S$: N, 10.16; Cl, 8.58. Found: N, 10.42; Cl, 8.4.

RESEARCH LABORATORIES OF
WINTHROP CHEMICAL COMPANY, INC.

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The Phenylhydrazone Hydrochloride and Some Substituted Phenylhydrazones of *d*-3-Methylcyclopentanone

BY G. H. STEMPEL, JR., W. O. FORSHEY, JR., AND GERSON S. SCHAFFEL

A survey of the literature has revealed that no phenylhydrazone of 3-methylcyclopentanone has been reported. It was therefore with some surprise that a white, crystalline precipitate was observed to form in a polarimeter tube in which the rate of the reaction of *d*-3-methylcyclopentanone with phenylhydrazine, in the presence of excess phenylhydrazine hydrochloride, was being studied by the method of Orning and Stempel.¹ Upon examination the precipitate proved to be the hydrochloride of *d*-3-methylcyclopentanone phenylhydrazone, the positive ion necessary for its formation resulting from the removal of a proton from the phenylhydrazonium ion by the phenylhydrazone. Attempts to prepare the phenylhydrazone itself from the salt were unsuccessful since the phenylhydrazone appears to be too unstable to handle, decomposing spontaneously and rapidly to give a tarry liquid. The hydrochloride is moderately stable when kept in contact with dilute hydrochloric acid solution, but decomposes slowly when dry.

(1) Orning and Stempel, *J. Org. Chem.*, **4**, 410 (1939).

A number of substituted phenylhydrazines were allowed to react with *d*-3-methylcyclopentanone, including the *p*-methoxy-, *p*-bromo-, *p*-nitro- and 2,4-dinitrophenylhydrazines. Of these only the *p*-nitro- and 2,4-dinitrophenylhydrazines yielded stable hydrazones.

Experimental

***d*-3-Methylcyclopentanone.**—This compound was prepared from *d*-pulegone by the following steps: (1) hydrolysis of *d*-pulegone to *d*-3-methylcyclohexanone by the method of Wallach²; (2) oxidation of the *d*-3-methylcyclohexanone to *d*- β -methyladipic acid by the method of Hartman³; and (3) cyclization of *d*- β -methyladipic acid, recrystallized several times from petroleum ether, to *d*-3-methylcyclopentanone by distilling with barium hydroxide according to the method of Thorpe and Kon.⁴ The *d*-3-methylcyclopentanone prepared in this way had the following properties: b. p. 145° corrected to 760 mm., $[\alpha]_D^{20}$ 153.28°, $[\alpha]_{D}^{25}$ 190.98°, n_D^{20} 1.4282. The rotation of this preparation agrees well with that reported by Godchot, *et al.*,⁵ for a sample prepared by cyclizing β -methyladipic acid with acetic anhydride: $[\alpha]_D^{20}$ 152.84°, $[\alpha]_{D}^{25}$ 188.88°, which in turn is considerably higher than rotations, $[\alpha]_D$, reported by Zelinsky⁶ (135.9°), Wallach⁷ (132.96°), and Richaud⁸ (130.09°). Godchot⁵ reported that the *d*-3-methylcyclopentanone formed by cyclization of his *d*- β -methyladipic acid by distilling with barium carbonate, instead of acetic anhydride, had a rotation of only 146.30°, indicating that partial racemization had occurred during the cyclization. It appears that no racemization took place during the cyclization using barium hydroxide reported here.

***d*-3-Methylcyclopentanone Phenylhydrazone Hydrochloride.**—To a mixture of 1 ml. (approx. 0.01 mole) each of phenylhydrazine and *d*-3-methylcyclopentanone was added 1–2 drops of glacial acetic acid. The mixture was kept at or below room temperature by cooling. After five to ten minutes 5 ml. of 1:10 hydrochloric acid was added, followed by enough 95% alcohol (5–10 ml.) to bring about complete miscibility. Then 10 ml. of ether and 2 ml. of concentrated hydrochloric acid were added. When the solution was allowed to evaporate at room temperature, glistening white needles of the hydrochloride separated. The product was then filtered off, washed quickly with alcohol, then ether, and dried in a vacuum desiccator. It had no definite melting point, rapid decomposition beginning at 35–40°. The yield varied from 0.5 to 0.7 g. in different runs.

Anal. Calcd. for $C_{12}H_{17}N_2Cl$: C, 64.13; H, 7.63. Found: C, 64.21; H, 7.48.

The hydrochloride decomposed rapidly enough when dry so that all weighings for analyses had to be made in sealed tubes. The salt-like nature of the hydrochloride was shown by its instantaneous reaction in aqueous solution with silver nitrate to precipitate silver chloride and by the determination of its neutral equivalent by titration with standard sodium hydroxide. Calcd.: neutral equivalent, 224.74. Found: neut. equiv., 226 and 227.

Substituted Phenylhydrazones of *d*-3-Methylcyclopentanone.—The *p*-nitrophenylhydrazone, yellow needle, melting at 155°, and the 2,4-dinitrophenylhydrazones orange needles melting at 144.5–145.5°, were prepared by the methods given by Shriner and Fuson.⁸ The melting

(2) Wallach, *Ber.*, **28**, 1965 (1895).

(3) W. W. Hartman, "Organic Syntheses," Coll. Vol. I, 2nd Edition, John Wiley and Sons, Inc., New York, N. Y., 1941, p. 19, Note 1.

(4) Thorpe and Kon, *ibid.*, p. 192.

(5) Godchot, Cauquil and Calas, *Bull. soc. chim.*, [5] **6**, 1357 (1939).

(6) Zelinsky, *Ber.*, **35**, 2489 (1902).

(7) Wallach, *ibid.*, **29**, 2965 (1896).

(8) Shriner and Fuson, "Identification of Organic Compounds," 2nd edition, John Wiley and Sons, Inc., New York, N. Y., 1940, pp. 142–143.