128–130°, reported m.p. 130–131°[2] and 129–130°.[3]

Anal. Calcd. for $C_{21}H_{18}O_2$: C, 83.42; H, 6.00. Found: C, 83.37; H, 5.91.

1,1-Diphenyl-2-anisyl-2-chloroethylene (V).—4-Methoxy-α-phenyldesoxybenzoin (IV) (0.30 g.) and phosphorus pentachloride (0.25 g.) in benzene (1 ml.) were refluxed for 3 hours. The crude product (0.2 g.) was crystallized from ethanol as colorless prisms, m.p. 123–124°.

Anal. Calcd. for $C_{21}H_{17}OCl$: C, 78.62; H, 5.03; Cl, 11.05. Found: C, 78.42; H, 5.30; Cl, 11.22.

***p*-Methoxy-ω-chloroacetophenone.**—Anisole (0.4 g.), chloroacetyl chloride (0.1 g.) and aluminum chloride (0.4 g.) in carbon disulfide (5 ml.) were kept for 20 hours at room temperature. Colorless needles were isolated which gave a positive Beilstein test for chlorine; m.p. 102–104°, reported[4] m.p. for *p*-methoxy-ω-chloroacetophenone 102°. When the above chlorides and anisole were heated in nitrobenzene on a water-bath, a dark resin was obtained.

(2) A. McKenzie and A. K. Mills, *Ber.*, **62**, 1792 (1929).
(3) R. Lagrave, *Ann. chim. phys.*, [10] **8**, 363 (1927).
(4) F. Kunckell and F. Johannssen, *Ber.*, **31**, 170 (1898).

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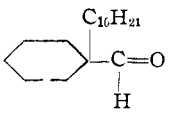
Ketone Formation by the Decarboxylation of α-*n*-Decyl Substituted Glycidic Acids

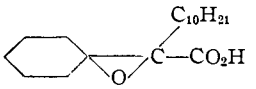
BY HORTON H. MORRIS AND CAROL JEAN ST. LAWRENCE[1]

RECEIVED AUGUST 30, 1954

A recent report[2] has shown that Darzens[3] was mistaken in stating that α-*n*-decylcyclohexanecarboxaldehyde (I) is produced by the decarboxylation

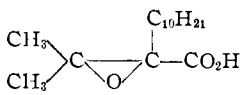


I

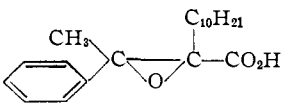


II

of α-*n*-decyl-α,β-epoxycyclohexylidene acetic acid (II). Since he also reported that the decarboxylation of α-*n*-decyl-β,β-dimethylglycidic acid (III)



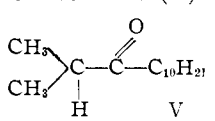
III



IV

and of α-*n*-decyl-β-methyl-β-phenylglycidic acid (IV) yielded aldehydes through a migration of the *n*-decyl radical, it seemed advisable to repeat the work.

The decarboxylation of III has been found to yield 2-methyl-3-tridecanone (V) as proved by alternate synthesis and the determination of mixed melting points of derivatives. As in the case of I, Darzens apparently was misled in his identification by traces of an easily oxidized contaminant in the decarboxylation product.



V

The melting point of the semicarbazone of V does not agree with the melting point of the semicarbazone of the product reported by Darzens and several variations of reaction conditions have been made in an attempt to duplicate the reported results. In every case only the ketone was formed upon decarboxylation of the glycidic acid. Since some glycidic esters have been reported[4,5] to rearrange to α-keto esters because of high distillation temperatures, and since the corresponding α-keto acid might be expected to yield I upon decarboxylation, a sample of ethyl α-*n*-decyl-β,β-dimethylglycidate was heated to 280–290° for two hours. Examination of the product after this treatment showed only unchanged glycidic ester.

Although numerous attempts have been made, no product which can be identified conclusively as ethyl α-*n*-decyl-β-methyl-β-phenylglycidate has been obtained in this Laboratory. The method of preparation reported by Darzens has been repeated, using the α-bromo ester in place of the α-chloro ester, but no glycidic ester could be isolated. The use of a method recently reported by Johnson, *et al.*,[6] which has given excellent results in the preparation of other glycidic esters gave an unidentified product having the correct analysis for the desired ester but which had properties differing greatly from those of the product reported by Darzens and which gave other tests indicating that it was not a glycidic ester.

Claisen's method[7] for the saponification of glycidic esters, involving the use of sodium ethoxide followed by exactly one equivalent of water, has proved more satisfactory than the usual methods.

The thermal decarboxylation of glycidic acids often gives low yields of decarboxylation product. In the case of III, however, the method proved to be satisfactory since it gave yields as high as that obtained by the modification of the method of Yarnall and Wallis reported by Johnson, *et al.*[6]

Experimental

Preparation of Intermediates.—The acetone was of C.P. grade and was carefully purified by fractional distillation before use. Matheson Company best grade acetophenone was used without further purification. Ethyl α-bromolaurate was prepared by the Hell–Volhard–Zelinsky reaction and was purified carefully by fractionation through a suitable column. The *t*-butyl alcohol was purified by repeated partial crystallization. Sodium ethoxide, when used as condensing agent, was prepared from a sodium dispersion and absolute ethanol by the method previously reported.[2]

Preparation of Ethyl α-*n*-Decyl-β,β-dimethylglycidate.—This ester was prepared from one mole (307 g.) of ethyl α-bromolaurate and one mole (58 g.) of acetone, using 1.6 moles of sodium ethoxide as the condensing agent according to the method given in an earlier report.[2] Fractionation through a Todd precise fractionation assembly gave 102 g. (36%) of a product with b.p. 169° (4 mm.), $n^{20}D$ 1.4430, d^{20}_4 0.9128, d^0_4 0.9276. Darzens[3] reports b.p. 162–165° (5 mm.), $n^{20}D$ 1.4612, d^0_0 0.993.

Anal. Calcd. for $C_{17}H_{32}O_3$: C, 71.77; H, 11.34; *MR*, 82.82; sapn. equiv., 284. Found: C, 71.74; H, 11.39; *MR*, 82.42; sapn. equiv., 281 ± 3.

As in previously reported cases,[2] a large amount (127 g.) of crude glycidic acid was obtained by acidifying the combined water and bicarbonate washes. Apparently the excess of condensing agent causes saponification when water is added at the conclusion of the reaction period.

(1) From the thesis submitted by C. J. St. Lawrence in partial fulfillment of the requirements of the degree of Master of Science in Chemistry, August, 1954.
(2) H. H. Morris and M. L. Lusth, THIS JOURNAL, **76**, 1237 (1954).
(3) G. Darzens, *Compt. rend.*, **195**, 884 (1932).
(4) E. Troell, *Ber.*, **61**, 2498 (1928).
(5) R. Pointet, *Compt. rend.*, **148**, 417 (1909).
(6) W. S. Johnson, J. Belew, L. Chinn and R. Hunt, THIS JOURNAL, **75**,4995 (1953).
(7) L. Claisen, *Ber.*, **38**, 693 (1905).

The ester was obtained in 70% yield by the addition of one mole of potassium *t*-butoxide (prepared under nitrogen from 39 g. of potassium metal in 800 ml. of *t*-butyl alcohol) to a mixture of one mole (307 g.) of ethyl α-bromolaurate and one mole (58 g.) of acetone, according to the method reported by Johnson, *et al.*[6]

In order to determine if the glycidic ester would rearrange on being subjected to high temperatures, a 8.9-g. sample was heated to 280–290° for two hours. Distillation after this treatment gave 7.2 g. of material boiling at 168° (4 mm.) and having a refractive index of 1.4431.

Saponification of Ethyl α-*n*-Decyl-β,β-dimethylglycidate. A sample of the ester was added to 1.5 times the equivalent amount of potassium hydroxide in diethylene glycol and the mixture refluxed for one hour. The cooled mixture was then poured into a slurry of concentrated hydrochloric acid and ice and immediately extracted with ether. The ether layer was washed with water, dried over anhydrous sodium sulfate and the ether removed by means of a steam-bath. The crude glycidic acid was a viscous oil which could not be obtained in a crystalline form.

Another sample of the ester was added to one equivalent of sodium ethoxide in excess ethanol. The cooled (ice-bath) mixture was then treated with exactly one equivalent of water and stirred for one hour. The mixture was poured into a concentrated hydrochloric acid–ice slurry whereupon a solid was formed. The mixture was extracted immediately with ether. The ether solution was washed, dried and the ether removed, leaving a solid acid which melted at 43–47°. Attempts to recrystallize the material gave only oils. On standing overnight the solid changed to a viscous liquid which could not be induced to crystallize. A 68% yield of ketone was formed by decarboxylating the glycidic acid obtained by the sodium ethoxide (Claisen method) saponification, whereas only a 42% yield of ketone was obtained from the decarboxylation of the saponification product where potassium hydroxide was employed. It would appear that the Claisen saponification yields a purer product than that obtained through the use of potassium hydroxide.

Since Darzens saponified this ester by the use of potassium hydroxide dissolved in ethanol, his procedure was repeated. The viscous acid so obtained decarboxylated smoothly to give a 42% yield of the ketone.

Decarboxylation of α-*n*-Decyl-β,β-dimethylglycidic Acid.—Thermal decarboxylation of samples of this acid following a previously reported[2] method gave yields varying from 42–69% depending upon the method used to saponify the glycidic ester. Fractionation (Todd assembly) of the mixtures after decarboxylation was complete gave a product with b.p. 133° (4 mm.), $n^{20}D$ 1.4357, d^{20}_4 0.8314, d^0_4 0.8443.

Anal. Calcd. for $C_{14}H_{28}O$: C, 79.24; H, 13.21; *MR*, 67.01. Found: C, 79.80; H, 13.22; *MR*, 67.22.

The material formed a 2,4-dinitrophenylhydrazone (yellow platelets) which melted at 32.5° after three recrystallizations from ethanol.

Anal. Calcd. for $C_{20}H_{32}O_4N_4$: N, 14.27. Found: N, 14.21.

It also formed a semicarbazone (84% yield based on ketone) which melted at 72.5–73° after three recrystallizations. Darzens[3] reported that his decarboxylation product boiled at 156–160° (18 mm.) and formed a semicarbazone which melted at 59.5°.

An authentic sample of 2-methyl-3-tridecanone was prepared from 0.25 mole of di-*n*-decylcadmium and 0.5 mole of isobutyryl chloride by the dialkylcadmium ketone synthesis. A detailed procedure has been given in an earlier report.[8] This material formed a 2,4-dinitrophenylhydrazone which melted at 32° and a semicarbazone which had a melting point of 72–73°. Mixed melting points of the similar derivatives from the authentic sample of ketone and the decarboxylation product showed no depression.

Although the decarboxylation product seemed pure, the material reduced Tollens reagent and decolorized a 1% permanganate solution. A sample of the material therefore was subjected to oxidation with aqueous potassium permanganate according to the method of Shriner and Fuson.[9] Less than 10% of the material was oxidized. The same results were obtained when a sample was dissolved in acetone and subjected to the oxidation. The presence of oxidizable material in the ketone probably accounts for Darzens' conclusion that the decarboxylation product was an aldehyde.

Johnson, *et al.*,[6] recently have reported a modification of Yarnall and Wallis' method of decarboxylating glycidic acids which involves the preparation of the α-chloro-β-hydroxy acid by treating the sodium salt of a glycidic acid with anhydrous HCl. The addition of a base causes the chlorohydroxy acid to decarboxylate. Use of this method with the sodium salt obtained by Claisen's method of saponification gave a 63% yield of 2-methyl-3-tridecanone (isolated as the 2,4-dinitrophenylhydrazone).

Attempted Preparation of Ethyl α-*n*-Decyl-β-methyl-β-phenylglycidate.—Although Darzens, using the α-chloro ester, reported no difficulty in obtaining the compound, we have not been able to obtain a product which could be shown to be the desired ester, using ethyl α-bromolaurate as starting material. Two attempts were made using sodium ethoxide as the condensing agent, but attempted distillation of the reaction products caused decomposition and the formation of undistillable tars. Four attempts were made to prepare the ester using potassium *t*-butoxide as the condensing agent. From the first three of these preparations no material was obtained which could be identified as the glycidic ester. The last preparation, in which the reaction mixture was allowed to stand overnight and was then heated for 2.5 hours on a steam-bath, gave 17 g. (10% yield if considered to be the glycidic ester) of a product with b.p. 205° (4 mm.), $n^{20}D$ 1.4853, d^{20}_4 0.9631. Darzens[3] reports b.p. 185–190° (5 mm.), $n^{20}D$ 1.4713, d^0_0 0.993.

Anal. Calcd. for $C_{22}H_{34}O_3$: C, 76.30; H, 9.83; *MR*, 102.53; mol. wt., 346. Found: C, 76.74; H, 9.86; *MR*, 103.01; mol. wt., 317, 321.

Although the analysis might indicate the expected glycidic ester, the molecular weight discrepancy and the following information leaves some doubt as to the nature of the product. A gas was evolved when a sample of the ester was saponified. No carbonyl derivative or acid derivative could be obtained from the acidified saponification mixture. The original reaction product decolorized a solution of bromine in carbon tetrachloride. In view of the possible rearrangement to the α-keto ester during the distillation, an attempt was made to obtain a 2,4-dinitrophenylhydrazone from the original reaction product but no derivative could be isolated. The material has not been identified conclusively.

Atomic refractivity values were taken from those given by Vogel.[10] Melting points are uncorrected. Analyses were made by the Oakwold Laboratories, Alexandria, Va. The infrared absorption curve of ethyl α-*n*-decyl-β,β-dimethylglycidate has been recorded by S. P. Sadtler Research Laboratories, 1517 Vine St., Philadelphia 3, Pa.

Acknowledgment.—We wish to express our appreciation for the financial aid given us by the Coe Research Fund and by a Frederick Gardner Cottrell research grant from Research Corporation.

(8) N. K. Nelson and H. H. Morris, THIS JOURNAL, **75**, 3337 (1953).

(9) R. L. Shriner and R. C. Fuson, "Identification of Organic Compounds," 3rd Ed., John Wiley and Sons, Inc., New York, N. Y.

(10) A. I. Vogel, "A Textbook of Practical Organic Chemistry Including Qualitative Analysis," 2nd Ed., Longmans, Green and Co., New York, N. Y.

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Synthetic Hypotensive Agents. II. Some Hexamethylene-1,6-bis-*t*-amines and Bis-quaternary Salts as Ganglionic Blocking Agents

BY ARTHUR P. PHILLIPS

RECEIVED NOVEMBER 6, 1954

An earlier study resulted in the discovery[1,2] of potent ganglionic blocking activity in a series of bis-tertiary amines, of structure I, as well as in their bis-quaternary ammonium salts. These compounds are believed to represent the first reported examples

(1) S. Norton and A. P. Phillips, *Nature*, **172**, 867 (1953).

(2) A. P. Phillips, THIS JOURNAL, **76**, 2211 (1954).