[CONTRIBUTION FROM THE WESTERN REGIONAL RESEARCH LABORATORY[1]]

γ-Palmitolactone and γ-Hydroxypalmitic Acid

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The synthesis of γ-palmitolactone (γ-dodecyl-γ-butyrolactone) was performed to obtain reference material in connection with investigations on dehydrochlorination of chlorinated palmitic acids. Delaby and Lecompte[2] reported that their preparation of the lactone from 4-hexadecenenitrile gave a product crystallizing at 35°. This value appears low in comparison with melting points of other recent preparations[3,4,5] of γ-substituted-γ-butyrolactones and their free hydroxy-acids. The γ-palmitolactone herein reported was made by reduction of γ-ketopalmitic acid prepared by Cason and Prout's modification[6] of the dialkylcadmium synthesis of Gilman and Nelson.[7] The product melted at 40.7–41.3°, in conformity with the properties of its homologs, and could be reoxidized to the keto-compound. Free γ-hydroxypalmitic acid, m. p. 79.0–79.6°, was readily obtained from, and reconverted to, the lactone. The free acid is stable at ordinary temperatures, but shows a slow conversion to the lactone at the melting point.

Experimental[8]

γ-Ketopalmitic acid.—The acid was prepared by the method of Cason and Prout.[6] Grignard reagent was made from 60.9 g. of redistilled reagent-grade dodecyl bromide and converted to didodecylcadmium by treatment with 23.8 g. of anhydrous cadmium chloride. The ether was replaced with benzene, and the resulting suspension was treated with 30 g. of β-carbomethoxypropionyl chloride[9] in 50 ml. of dry benzene. The recovered reaction products were fractionally distilled from a Claisen flask at 2 mm. Fractions 3 (14.9 g., boiling at 160–165°) and 4 (4.4 g., boiling at 165–182°), corresponding to a 33.5% yield based on the acid chloride, were used to obtain the desired keto acid.

The ester was accompanied by a difficultly removable neutral material. Accordingly, the mixture was saponified, and the unsaponified portion was extracted with Skellysolve F. After crystallization from the same solvent, this neutral substance formed waxy flakes with m. p. 50–50.5°. It appeared to be **tetracosane**, from coupling of the Grignard reagent.

Anal. Calcd. for $C_{24}H_{50}$: C, 85.12; H, 14.88. Found: C, 84.9; H, 14.8.

The keto acid, freed from unsaponifiables, was extracted with ether from the acidified solution. Crystallization from ether gave 4.85 g. of purified γ-ketopalmitic acid, m. p. 91.5–92.5°. Robinson and Robinson[10] reported a m. p. of 91–92°.

γ-Palmitolactone.—Treatment of 5.0 g. of the keto acid with 4% sodium amalgam in aqueous alkaline solution[11] left 1.95 g. of unreacted keto acid. Crystallization of the reduced product from Skellysolve F yielded 1.25 g. of γ-palmitolactone, m. p. 40.7–41.3°. Delaby and Lecompte[2] reported a crystallization temperature of 35°.

Anal. Calcd. for $C_{16}H_{30}O_2$: C, 75.53; H, 11.89. Found: C, 75.6; H, 11.9.

Reoxidation of the γ-Lactone.—Oxidation of 1.05 g. of the lactone with chromic acid in glacial acetic acid,[12] and crystallization from Skellysolve F and ether, yielded 0.65 g. of unoxidized lactone and 0.3 g. of γ-ketopalmitic acid, m. p. 91.8–92.2°, showing no melting point depression with the original keto acid.

γ-Hydroxypalmitic Acid.—A 200-mg. portion of the γ-lactone was converted to the sodium salt by refluxing with excess aqueous alkali. The solution was cooled and made faintly acid with hydrochloric acid. The precipitate, after filtering, drying and crystallizing from acetone, melted at 79.0–79.6°.

Anal. Calcd. for $C_{16}H_{32}O_3$: C, 70.54; H, 11.84. Found: C, 70.6; H, 11.9.

The γ-hydroxy acid was readily reconverted to the γ-lactone by refluxing with 15% hydrochloric acid[5] and crystallizing from acetone.

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Summary

γ-Ketopalmitic acid, prepared from β-carbomethoxypropionyl chloride and didodecylcadmium, has been reduced to yield γ-palmitolactone, m. p. 40.7–41.3°. The lactone was readily converted to, and regenerated from, γ-hydroxypalmitic acid, m. p. 79.0–79.6°. The free hydroxy acid is stable at ordinary temperatures, but is slowly converted to the lactone at the melting point.

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[1] Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture.

[2] Delaby and Lecompte, *Bull. soc. chim.*, [5] **4**, 1011 (1937).

[3] Rothstein, *ibid.*, [5] **2**, 1936 (1935).

[4] Chuit, Boelsing, Hausser and Malet, *Helv. Chim. Acta*, **10** 113 (1927).

[5] Clutterbuck, *J. Chem. Soc.*, **125**, 2330 (1924).

[6] Cason and Prout, THIS JOURNAL, **66**, 46 (1944).

[7] Gilman and Nelson, *Rec. trav. chim.*, **55**, 518 (1936).

[8] All melting points are corrected.

[9] "Organic Syntheses," **25**, 19 (1945).

[10] Robinson and Robinson, *J. Chem. Soc.*, **127**, 175 (1925).

[11] Blaise and Köhler, *Bull. soc. chim.*, [4] **7**, 411 (1910).

[12] Kuwata, THIS JOURNAL, **60**, 559 (1938).