

*Anal.* Calcd. for  $C_{14}H_{19}NO_5S$ : C, 53.67; H, 6.07; N, 4.47. Found: C, 53.86; H, 6.01; N, 4.30.

(1-Nitrocyclohexyl)methyl bromide. To a cool ( $0^\circ$ ) mixture of 15.9 g. (0.1 mole) of (1-nitrocyclohexyl)methanol and 16.8 g. (0.13 mole) of quinoline in 500 ml. of bromobenzene was added slowly 20.3 g. (0.075 mole) of phosphorus tribromide. The mixture was heated at  $150^\circ$  for 5 hr. and then allowed to stand at room temperature for several days. The bromobenzene solution was poured into cold water, separated, and dried over magnesium sulfate. The residue obtained after removal of the solvent *in vacuo* was distilled to give 12.5 g. (0.056 mole) of nitro bromide, b.p.  $94.5\text{--}95^\circ$  (1 mm.),  $n_D^{23.5}$  1.5100.

*Anal.* Calcd. for  $C_7H_{12}BrNO_2$ : C, 37.86; H, 5.45; Br, 35.98; N, 6.30. Found: C, 38.07; H, 5.37; Br, 36.14; N, 5.93.

1-Nitrocyclohexanecarboxylic acid. A mixture of 80 g. (0.5 mole) of (1-nitrocyclohexyl)methanol and 80 ml. of dinitrogen tetroxide in 640 ml. of chloroform was allowed to stand at room temperature for one week, during which time a water layer formed slowly. The chloroform layer was separated and then concentrated *in vacuo* to give a white, waxy solid. Recrystallization of this material by dissolution in ether-cyclohexane mixture and then pumping off the ether gave 62 g. (72% yield) of product which melted at  $83\text{--}84^\circ$ , with decomposition, to first a blue and then a brown liquid. The nitro acid dissolved readily in 2% aqueous sodium hydroxide solution. Acidification of the basic solution at room temperature caused the evolution of carbon dioxide.

*Anal.* Calcd. for  $C_7H_{11}NO_4$ : C, 48.55; H, 6.36; N, 8.09. Found: C, 48.94; H, 6.62; N, 8.05.

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## Identity of Mevalonic and Hiochic Acids

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A new acetate-replacing and growth factor for *Lactobacillus acidophilus*, ATCC 4963, was reported recently.<sup>1,2</sup> The structure of this compound was proved to be 3,5-dihydroxy-3-methylpentanoic acid (I),<sup>3,4</sup> and it was given the generic name, mevalonic acid (and corresponding lactone, II). This compound was found to be utilized in the biosynthesis of cholesterol by rat liver homogenates.<sup>5</sup>

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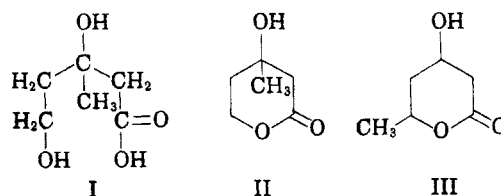
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(5) Peter A. Tavormina, Margaret H. Gibbs, and Jesse W. Huff, *J. Am. Chem. Soc.*, **78**, 4498 (1956); Peter A. Tavormina and Margaret H. Gibbs, *J. Am. Chem. Soc.*, **78**, 6210 (1956).

A new growth factor, designated hiochic acid, indispensable for the growth of "true Hiochi bacteria" (*Lactobacillus homohiochi* and *Lactobacillus heterohiochi*) was reported to be present in Japanese rice wine (Sake), and also in the culture broth of several organisms such as *Aspergillus*, *Penicillium*, *Monilia*, and *Lactobacillus*.<sup>6</sup> This factor was produced from the broth in which *Aspergillus oryzae* was grown. The studies on the factor revealed four structures which were compatible with the observations. Structure III seemed to be the most probable on the basis of a distinctly positive iodoform test. The negative iodoform test<sup>3</sup> on mevalonic acid,



when reexamined, gave a trace of iodoform, but when the test was compared with companion positive and negative control compounds, the test with mevalonic acid was considered again to be negative. The yield of iodoform with the positive control compounds was nearly quantitative. It is considered possible that mevalonic acid might be degraded to methyl  $\beta$ -hydroxyethyl ketone in trace amounts under the iodoform test conditions and this compound would be converted to iodoform.

The published infrared spectrum<sup>6</sup> of hiochic acid and that of mevalonic acid are identical. Samples (*N,N'*-dibenzylethylenediammonium bis-DL-mevalonate and hiochic acid quinine salt) were exchanged for comparison. The DL-mevalonic acid was found to have one half the microbiological activity for *Lactobacillus heterohiochi* as compared with hiochic acid, and the hiochic acid was found to have the same activity for *Lactobacillus acidophilus*, ATCC 4963 as mevalonic acid.

Since the infrared spectra of mevalonic acid and hiochic acid are identical, and they have the same microbiological activities for the microorganisms tested, it appears evident that hiochic acid is identical with mevalonic acid and is, therefore, 3,5-dihydroxy-3-methylpentanoic acid (I).<sup>7</sup>

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