

Summary

In the Tollens reaction and fused reaction, mannuronic acid and galacturonic acid proved to react with 1,3-naphthalendiol in the same mechanism as glucuronic acid by isolating the coloring matters in a crystalline form.

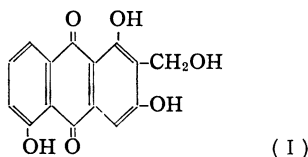
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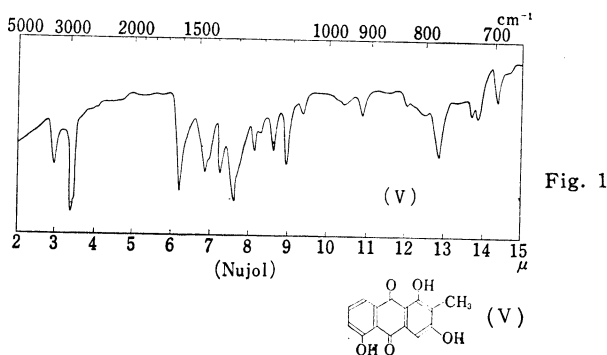
**Yoshio Hirose, Naohisa Sasaki, Eiko Kawagishi, and
Susumu Nonomura : Synthesis of Nor-Juzunol.¹⁾**

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In the previous paper¹⁾ the synthesis of nor-juzunol whose structure corresponded to 2-hydroxymethyl-1,3,5-trihydroxyanthraquinone (I) was reported. This paper is concerned with confirmation of the position of a hydroxymethyl group in the molecule of 1,3,5-trihydroxyanthraquinone (II).



Direct condensation of *m*-hydroxybenzoic acid (III) and 4-methyl- α -resorcylic acid (IV) by conc. sulfuric acid and boric acid gave 2-methyl-1,3,5-trihydroxyanthraquinone (V), m. p. 280°, whose infrared spectrum showed bands at 3367 cm⁻¹ (OH), 1608 cm⁻¹ (chelated C=O) and 1563 cm⁻¹ (phenyl), and no absorption of non-chelated C=O as shown



in Fig. 1. In this condensation 1,5-dihydroxy-, and 2,6-dimethyl-1,3,5,7-tetrahydroxyanthraquinone were also obtained. 2-Bromomethyl-1,3,5-trihydroxyanthraquinone triacetate (VII), m. p. 242~244°, obtained by bromination of the triacetate (VI), m. p. 239.5~240.5°, of (V) with *N*-bromosuccinimide, was then converted into 2-hydroxymethyl-1,

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1) Y. Hirose: This Bulletin, 8, 417 (1960).

3,5-trihydroxyanthraquinone tetraacetate (VIII), m. p. 236~237°, which was hydrolyzed with 3% methanolic sulfuric acid solution to 2-hydroxymethyl-1,3,5-trihydroxyanthraquinone (IX), m. p. >300° (decomp.). (IX) was confirmed by direct infrared spectra comparison to be identical with (I), and a mixed fusion of (VIII) with the tetraacetate of (I) also showed no depression in the melting point.

The above results indicated that the hydroxymethylation of (II) proceeded in such a way as to give (I), viz. (IX), as the sole product. Since conversion of nor-juzunal was reported in the previous paper¹⁾, the synthesis of nor-juzunol furnishes an additional evidence to a conclusion from that of nor-juzunal.

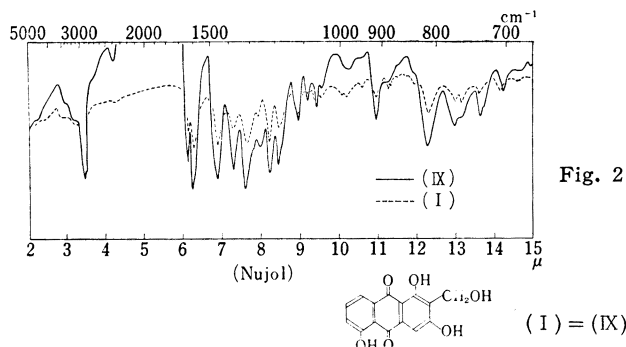


Fig. 2

Experimental

2-Methyl-1,3,5-trihydroxyanthraquinone (V)—(V) was prepared by heating a mixture of *m*-hydroxybenzoic acid (III) (1 g.), 4-methyl- α -resorcylic acid (IV) (1 g.), boric anhydride (1 g.) and conc. H₂SO₄ (3 cc.) to 125~130° for 15 min. with intermittent shaking. After cooling, the reaction mixture was poured into water, and the precipitate was repeatedly extracted with benzene. The combined benzene extracts were evaporated and the residue was chromatographed on paper (Toyo Roshi No. 50) using BuOH saturated with 28% NH₄OH as the developing solvent. From the fractions giving a spot of R_f, 0.64, yellow needles, m. p. 280°, were obtained after recrystallization from AcOH; yield, 50 mg. This substance and its acetate, m. p. 244°, were found to be identical by mixed fusion with authentic samples of 1,5-dihydroxyanthraquinone and its acetate. The fractions giving R_f, 0.43 gave orange-yellow fine needles, (V), m. p. 280°, after recrystallization from aq. Me₂CO. Yield, 0.1 g. *Anal.* Calcd. for C₁₅H₁₀O₅: C, 66.67; H, 4.29.

From the fractions of R_f, 0.15 spot, there were obtained orange-red pillars, m. p. 333° (decomp.), after recrystallization from aq. Me₂CO; yield, 50 mg. This substance and its acetate, m. p. 278~279°, were found to be identical with 2,6-dimethyl-1,3,5,7-tetrahydroxyanthraquinone, m. p. 333°²⁾ (dimethylanthrachryson) and 2,6-dimethyl-1,3,5,7-tetraacetoxyanthraquinone, m. p. 278~279° by direct comparison. Dimethylanthrachryson is sparingly soluble in benzene.

2-Methyl-1,3,5-trihydroxyanthraquinone triacetate (VI)—(V) (200 mg.) was heated with Ac₂O (10 cc.) and a drop of conc. H₂SO₄ on a water bath at 60~80° for 1 hr. On crystallization from AcOH the product formed yellow needles (200 mg.), m. p. 239.5~240.5°. *Anal.* Calcd. for C₂₁H₁₆O₈: C, 63.63; H, 4.07. Found: C, 64.00; H, 4.21.

Trimethyl Ether of (V)—It was prepared in the usual way and crystallized from Me₂CO. Yellow needles, m. p. 184~185°. *Anal.* Calcd. for C₁₈H₁₆O₅: C, 69.22; H, 5.16. Found: C, 69.57; H, 5.51.

2-Bromomethyl-1,3,5-trihydroxyanthraquinone triacetate (VII)—A solution of (VI) (0.3 g.), *N*-bromomethylsuccinimide (0.3 g.), and B₂O₃ (0.05 g.) in dried CCl₄ (50 cc.) was refluxed for 15 hr. After removing the solvent, the viscous residue was washed with hot water, and crystallized from Me₂CO-EtOH (1:1) to yellow needles, m. p. 242~244°. It was employed for the subsequent step without further purification. (VII) is very slightly soluble in EtOH.

2-Hydroxymethyl-1,3,5-trihydroxyanthraquinone tetraacetate (VIII)—A mixture of (VII) (0.3 g.), AcONa (0.3 g.) and Ac₂O (15 cc.) was refluxed in an oil bath for 1 hr. (VIII) was recrystallized from aq. Me₂CO to pale yellow needles (0.2 g.), m. p. 235~236° undepressed on admixture with the tetraacetate,

2) T. Kusaka: Yakugaku Zasshi, 55, 682 (1925).

m.p. 236~237°, of (I) which was obtained by hydroxymethylation of (II).¹⁾ *Anal.* Calcd. for C₂₃H₁₈O₁₀ : C, 60.79; H, 3.99. Found : C, 61.15; H, 3.82. IR $\nu_{\max}^{\text{Nujol}}$ cm⁻¹ : 1764(phenolic AcO), 1748(enolic AcO), 1678(nonchelated C=O), 1597(phenyl).

2-Hydroxymethyl-1,3,5-trihydroxyanthraquinone (IX)—(VIII)(0.1 g.) was dissolved in MeOH(60 cc.) by warming and the solution set aside at room temperature. Conc. H₂SO₄(1 cc.) was added, and the solution was refluxed for 0.5 hr. On dilution with water the product separated was recrystallized from aq. Me₂CO to yellow plates, m.p. >300°; yield, 50 mg. *Anal.* Calcd. for C₁₅H₁₀O₆ : C, 62.94; H, 3.52. Found : C, 62.47; H, 3.92. IR $\nu_{\max}^{\text{Nujol}}$ cm⁻¹ : 3390(phenolic OH), 3226~3049(enolic OH), 1639(chelated C=O), 1608(phenyl), 1595(phenyl, shoulder).

Summary

It was shown that the hydroxymethylation of 1,3,5-trihydroxyanthraquinone (II) took place at 2-position of its molecule.

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