

Studies on Digitalis Glycosides : Structure of Digiprolactone

A number of cardiotonic and non-cardiotonic glycosides have been isolated from *Digitalis purpurea* leaves. In 1956, the authors reported the isolation of crystal G.¹⁾ This paper describes the elucidation of its structure.

Crystal G (I) was recrystallized from acetone-petroleum ether as needles, m.p. 149/151°, $C_{11}H_{16}O_3$, $[\alpha]_D^{25} -100.5^\circ$ ($c=1.103$, chloroform), UV : λ_{max}^{EtOH} 214 m μ ($\log \epsilon$ 4.15), IR μ : 2.90 (OH), 5.78 (C=O), 6.18 (C=C). Acetylation of I afforded a monoacetate (II), m.p. 77.5~79°, $C_{13}H_{18}O_4$, $[\alpha]_D^{25} -68.5^\circ$ ($c=1.065$, chloroform), UV : λ_{max}^{EtOH} 212 m μ ($\log \epsilon$ 4.23), which showed no hydroxyl band in its infrared spectrum. Oxidation of I with chromic anhydride gave a monoketone (III), m.p. 92~96°, $C_{11}H_{14}O_3$, $[\alpha]_D^{25} -6.0^\circ$ ($c=1.060$, chloroform), UV : λ_{max}^{EtOH} 212 m μ ($\log \epsilon$ 4.19), which showed no hydroxyl band in its infrared spectrum. III gave a monooxime. Catalytic hydrogenation of I with 2% palladium-charcoal gave a dihydro derivative (IV), m.p. 77~77.5°, $C_{11}H_{18}O_3$, $[\alpha]_D^{25} 10.6^\circ$ ($c=1.070$, chloroform).

As the molecule had one extra carbon as compared to monoterpenoids, the molecular weight of II was determined and agreed well with the calculated value.

Infrared and ultraviolet spectra of I, II, and III showed the presence of α,β -unsaturated butenolide ring in their molecules. IV had the saturated butenolide ring, which was hydrolyzed with 1 mole of potassium hydroxide. These results showed that two of the three oxygen atoms in I belonged to the lactone ring, and the remaining one to the hydroxyl group. The molecular formula suggested that this compound was bicyclic including α,β -unsaturated butenolide ring.

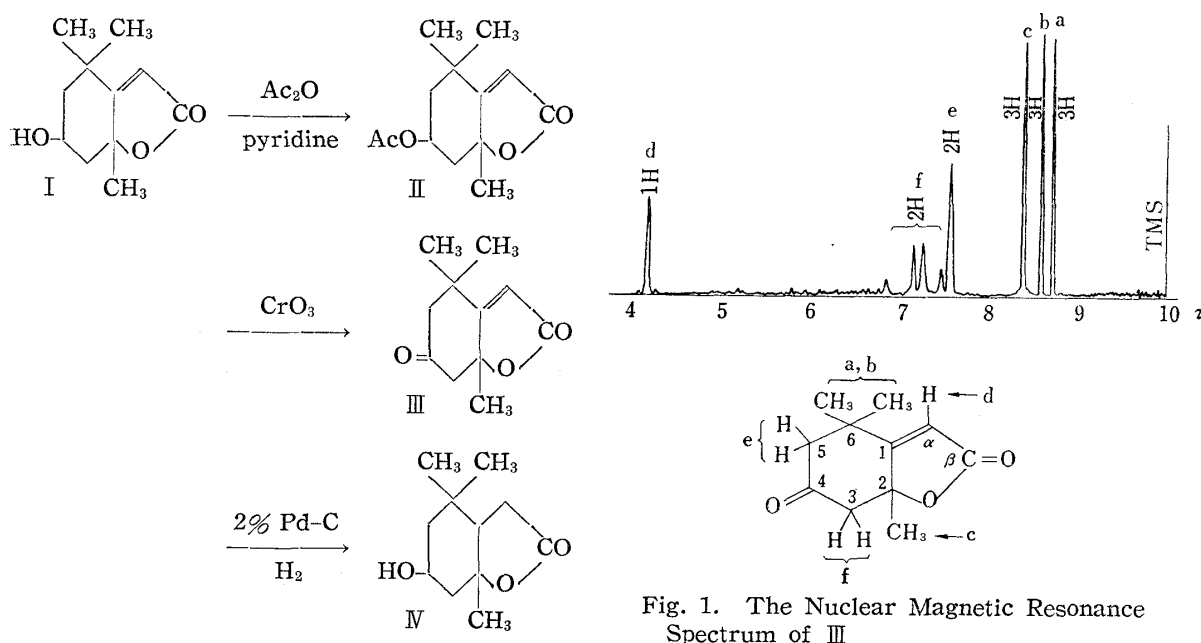


Fig. 1. The Nuclear Magnetic Resonance Spectrum of III

The nuclear magnetic resonance spectra of I, II, III, and IV showed signals of three singlet methyl groups respectively. The hydrogen at $-O-CH-$ grouping of lactone ring was not found in these four compounds.

The nuclear magnetic resonance spectrum of III was illustrated in Fig. 1. The molecule of III contained fourteen hydrogen atoms. Among them, nine was distributed

1) D. Satoh, H. Ishii, Y. Oyama, T. Wada, T. Okumura : This Bulletin, 4, 284 (1956).

to three methyl groups, one on a double bond, and remaining four existed as two isolated methylene groups at the both sides of the keto group. The presence of hydrogen at C-6 was excluded by sharp singlet signal of d.

From these data, the plane structure of crystal G was deduced to be 2,4-dihydroxy-2,6,6-trimethyl- $\Delta^{1,\alpha}$ -cyclohexaneacetic acid ($\beta \rightarrow 2$) lactone (I).

As this compound had not been reported in the literature, crystal G was designated as digiprolactone.

The absolute configurations at C-2 and at C-4 will be reported in the near future.

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