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THE STEREOCHEMISTRY OF FUKIIC ACID AND PISCIDIC ACID.

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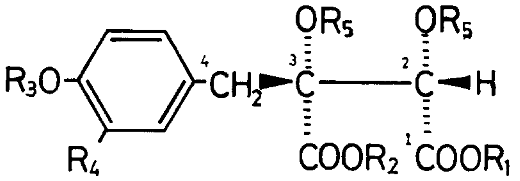
Recently the structures of fukiic acid1) and piscidic acid2) have been established as 3,4-dihydroxybenzyl tartaric acid and p-hydroxybenzyl tartaric acid, respectively. In this communication we wish to report that these two analogous compounds have the same stereochemistry depicted as I and II.



I, $R_1 \sim R_3$, R_5=H; R_4=OH

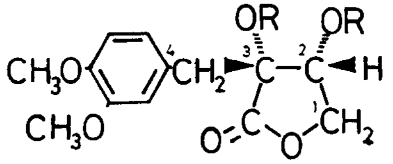
II, $R_1 \sim R_5$ =H

III, $R_1 \sim R_3 = CH_3$; $R_4 = OCH_3$; R_5 = H

VIII, $R_1 = CH_3$; $R_2 \sim R_5$ =H

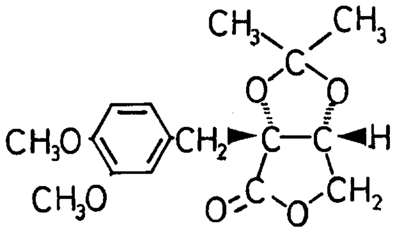
IX, $R_1, R_2 = CH_3$; $R_3 \sim R_5$ =H; R_4=OH

The relative configuration of fukiic acid was determined as follows. By means of $NaBH_4$, fukiic acid dimethoxydimethylester (III), which was obtained by methylation of **fukiic** acid with diazomethane, was converted to a lactone (IV); ir $\nu_{max}^{CCl_4}$ 1782 cm^{-1} (saturated γ-lactone); nmr δ (d_6-acetone), 2.95 (2H, s, C_4-H), 3.76 (6H, s, CH_3O-), 4.0~4.3 (3H, m, C_1-H and C_2-H), 6.82 (2H, s, ArH), 6.92 (1H, s, ArH). The lactone IV was acetylated with acetic anhydride in pyridine to a diacetate V: m.p. 112~113°: $C_{17}H_{26}O_8$; M^+ m/e 352; ir ν_{max}^{KBr} 1785 (saturated γ-lactone), 1755 (acetyl c=O) cm^{-1}; nmr δ ($CDCl_3$), 2.06 and 2.15 (3H, s, $2CH_3CO$-), 3.28 (2H, s, C_4-H), 3.86 (6H, s, $2CH_3O$-), 3.85 (1H, d, C_1-H, J=7.8 Hz), 4.08 (1H, d, C_1-H, J=4.8 Hz), 5.48 (1H, q, C_2-H, J=4.8 and 7.8 Hz), 6.82 (3H, s, ArH). Since the nmr spectrum of V has the signals at δ 3.85, 4.08 and 5.48 due to ABX spin system, it is quite evident that the reduction was occured at carbomethoxy group attached at C-2 in compound III. The ir spectrum of the lactone IV under high dilute conditions (3.1×10^{-4} mole)

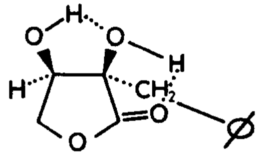


IV, R = H

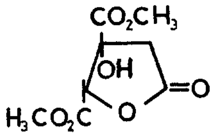
V, R = CH_3CO



VI



A



VII

in carbon tetrachloride showed only one absorption band at 3575 cm^{-1}, which indicates that absorption bands due to two kinds of hydrogen bonds arising from a moiety A are overlapped$^{3)}$.

Further evidence for relative configuration was obtained from the formation of acetonide VI. m.p. 135∼136°, $C_{16}H_{20}O_6$. M^+ m/e 308; ν_{max}^{KBr} 1778 cm^{-1} (γ-lactone), which was prepared from IV on treatment with p-toluenesulfonic acid in acetone. These results suggest that the lactone IV has a cis diol and hence I has an erythro configuration.

In order to determine the absolute configuration of fukiic acid, Horeau's method$^{4)}$ was employed. The lactone IV (1.87×10^{-4}mole) was allowed to react with α-phenylbutyric anhydride (3.74×10^{-4}mole) in pyridine. After hydrolysis, resultant α-phenybutyric acid showed a rotation of $[\alpha]_D^{20}$ +7.97 (c=3.97, benzene, optical yield 25.0%). Since the relative size of the substituent groups should be arranged in the order, H(S), $-CH_2-$(M), $HO-\overset{|}{\underset{|}{C}}-CO_2CH_3$ (L), it is concluded that the stereochemistry at C-2 is S-configuration.

Further support of this result and the identity of absolute configurations between piscidic acid and fukiic acid were proved by exhaustive ozonolysis of these two compounds to hibiscus acid whose stereochemistry had been unequivocally established$^{5)}$. Thus ozonolysis$^{6)}$ of piscidic acid monomethylester (VIII)(92.9 mg) and then treatment with methanolic hydrogen chloride yielded an oily substance (15 mg homogeneous on TLC); nmr δ (d_6-acetone): 2.70 (1H, d, J=17 Hz), 3.23 (1H, d, J=17 Hz), 3.73 (3H, s), 3.83 (3H, s), 5.32 (1H, s), 5.54 (1H, s); ORD λ_{max}^{MeOH} 232 nm $[\phi]$ = +10,800, CD λ_{max}^{MeOH} 215 nm $[\theta]$ = +12,500. These figures are compatible with those of hibiscus acid dimethylester (VII); (lit[5]., ORD λ_{max}^{MeOH} 230 nm $[\phi] = +10,887$, CD λ_{max}^{MeOH} 214 nm $[\theta] = +14,525$). The same method was applied to fukiic acid dimethylester (IX, 22 mg) to yield hibiscus acid dimethylester (VII) (3.1 mg), ORD λ_{max}^{MeOH} 232 nm $[\phi] = +11,100$, CD λ_{max}^{MeOH} 215 nm $[\theta] = +13,900$, exhibiting nmr spectrum identical with that of ozonolysis product from piscidic acid monomethylester.

All data above provide the evidence that both piscidic acid and fukiic acid have the same absolute configuration, S-configuration at C-2 and R-configuration at C-3.

References and Footnotes

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3) If IV has a trans configuration, there should be appeared an absorption band due to free hydroxy group, cf. L.P. Kuhn. *J. Amer. Chem. Soc.*, *74* , 2492 (1952); E.L. Eliel and C. Pillar. *ibid.*, *77* , 3600 (1955).

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