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STRUCTURAL CORRELATION BETWEEN CAPENICIN AND TUTIN

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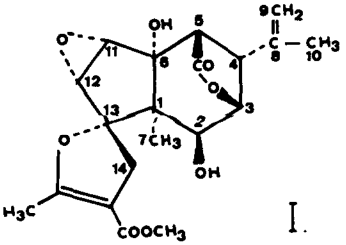
Studies on the terpenic lactones of Toxicodendrum capense, Thunb. (Hyaenanche globosa, Lamb.) resulted in the isolation of hyenanchin (1), isodihydrohyenanchin (1), its 2-O methylether (2), tutin (3), capenicin (4) and other compounds.
Recently (4) the structure of capenicin has been proposed as (I); evidences are now presented which confirm this structure *and establish its absolute configuration.*



I.

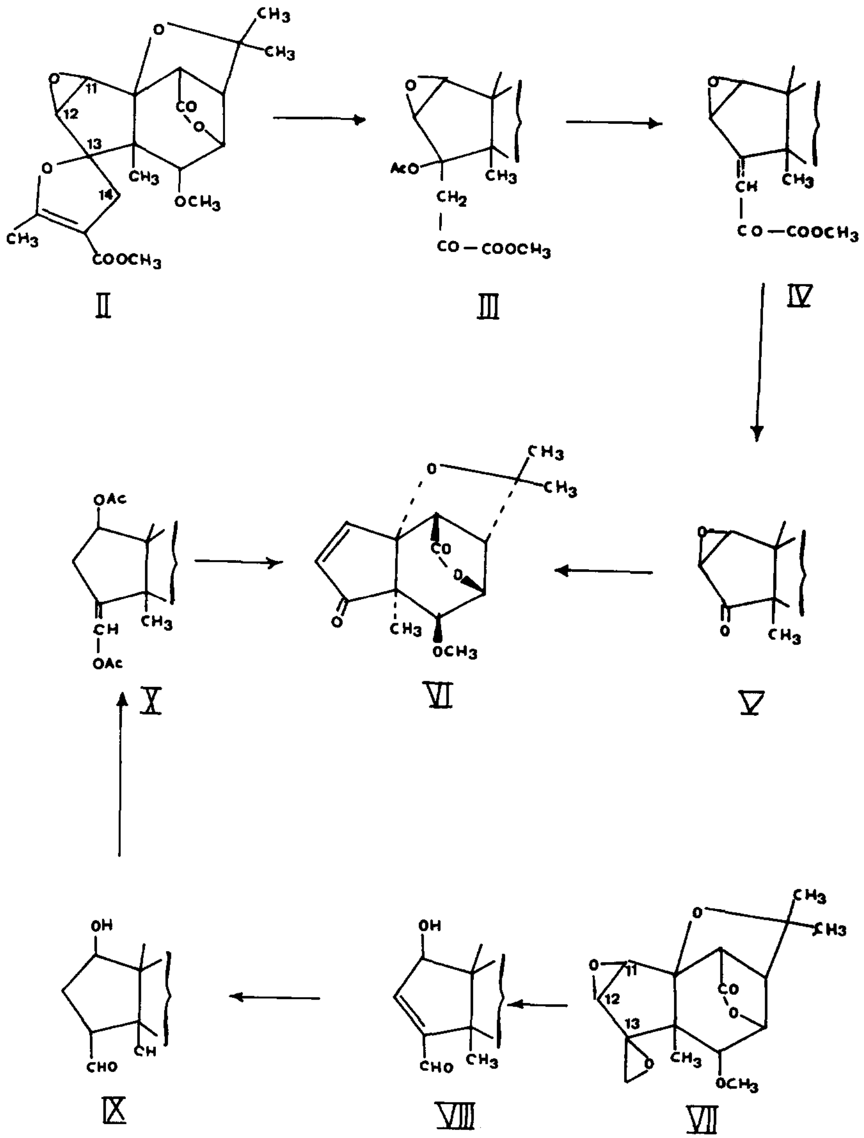
The oxidation of isocapenicin 2-O methylether (4) (II) [$C_{21}H_{26}O_8$; λ_{max} *256 mμ (CH_3OH)* ; ν_{max} *1779, 1695 and 1661 cm^{-1} (nujol)* ; N.M.R. (d_5-Py) 3.39 (3H, s, CH_3-O-C_2) , 2.28 (3H, s, $CH_3-\overset{|}{C}=$) , 3.09 and 4.42 (2H, d, $-CH_2-C_{13}$, J_{gem}=16 cps) , 3.78 and 3.96 (2H, d, $\underset{O}{H-\overset{|}{C}—\overset{|}{C}-H}$, J= 3 cps)] with chromium trioxide in acetic acid, gave (III) (4) [$C_{21}H_{26}O_{10}$; m.p. 138-40° ; no absorption in

U.V.; N.M.R. ($CDCl_3$) 2.13 (3H, s, CH_3-COO-) , 3.6 and 4.21 (2H, d, $\underset{O}{\mathrm{H{-}\overset{|}{C}{-}\overset{|}{C}{-}H}}$, J= 3 cps)] which on treatment with pyridine, was led to (IV) [$C_{19}H_{22}O_8$; m.p. 113-5° ; λ_{max} 275 mμ (ε= 7800 , CH_3OH) ; ν_{max} 1780 (γ-lactone) , 1735 (ester) , 1700 (unsaturated ketone) and 1625 cm^{-1}(double bond) ($CHCl_3$)] . The N.M.R. spectrum ($CDCl_3$) shows signals at 1.4 (3H, s, CH_3-C_1) , 1.53 and 1.58 (6H, s, $\mathrm{CH_3{-}\overset{\vee}{C}_8{-}CH_3}$) , 3.13 (2H, m, H-$C_4$ and H-C_5) 3.8 and 5.0 (2H, d, $\underset{O}{\mathrm{H{-}\overset{|}{C}{-}\overset{|}{C}{-}H}}$, J=3 cps),3.78 (1H, d, H-C_2 ,J=3 cps), 3.56 (3H, s, CH_3-O-C_2) , 3.87 (3H, s, CH_3-O-CO-),4.96 (1H, dd, H-C_3 , $J_{3,2}$=3 cps , $J_{3,4}$=8 cps) , 7.88 (1H, s, H-C_{14}).

By the ozonolysis of (IV), we obtained the very unstable ketone (V) [ν_{max} 1772 (γ-lactone) and 1748 cm^{-1}(ketone)(nujol)] which was then treated with chromous chloride in neutral solution to give the unsaturated ketone (VI) [$C_{15}H_{18}O_5$; m.p. 171-3° ; λ_{max}220 mμ (ε=7250 , H_2O) ; ν_{max} 1770 (γ-lactone), 1718 (unsaturated ketone) and 1588 cm^{-1}(double bond)(KI) ; N.M.R. ($CDCl_3$) signals at 1.4 (3H, s, CH_3-C_1) , 1.51 and 1.57 (6H, s, $\mathrm{CH_3{-}\overset{\vee}{C}_8{-}CH_3}$) 3.25 (2H, m, H-$C_4$ and H-C_5) , 3.63 (3H, s, CH_3-O-C_2) , 4.0 (1H, d, H-C_2 , J=3 cps) , 4.97 (1H, dd, H-C_3, $J_{3,2}$=3 cps , $J_{3,4}$= 7 cps) , 6.15 and 7.30 (2H, d, $\mathrm{H{-}\overset{|}{C}_{11}{=}\overset{|}{C}_{12}{-}H}$, J=6 cps) ;$[\alpha]_D$-96,8° (dioxan 1%)].

On treatment with sulfuric acid , isotutin 2-O methylether (from "D" substance (4)) afforded the hydroxy-unsaturated aldehyde (VIII) [λ_{max}230 mμ (H_2O) ; ν_{max} 3440 (-OH), 1785 (γ-lactone) , 1685 (unsaturated aldehyde) and 1587 cm^{-1}(double bond)(nujol) ; N.M.R. (d_5-Py + D_2O) 1.40 and 1.60 (6H, s, $\mathrm{CH_3{-}\overset{\vee}{C}_8{-}CH_3}$) , 1.98 (3H, s, CH_3-C_1) , 3.30 (1H, d, H-C_5, J=3 cps) 3.50 (3H,s, CH_3-O-C_2) , 3.50 (1H, H-C_4) , 4.02 (1H, d,H-C_2, J= 3 cps), 5.0 (1H, d, H-C_{11}, J=3 cps), 5.2 (1H, dd, H-C_3, $J_{3,2}$ and $J_{3,4}$ = 3 cps) , 6.9 (1H, d, H-C_{12} , J= 3 cps)and 10.12 (1H, s, H-C_{14})].

Compound (VIII) was hydrogenated in dioxane solution over palla-



II
III
IV
V
VI
VII
VIII
IX
X
11
12
13
14
CH3
COOCH3
OCH3
AcO
CH2
CO — COOCH3
CH
CO — COOCH3
OAc
OH
CHO

dium-charcoal catalyst to the saturated aldehyde (IX) [$C_{16}H_{22}O_6$; no absorption in U.V. ; ν_{max} 1778 (γ-lactone) and 1720 cm^{-1} (saturated aldehyde)($CHCl_3$)] ; this compound in refluxing acetic anhydride and in the presence of sodium acetate, yielded the acetate-enolacetate (X), $C_{20}H_{26}O_8$. The properties of (X) are as follows: ν_{max} 1780 (γ-lactone) and 1750 (two -OAc)(nujol) ; N.M.R. ($CDCl_3$) no aldehydic protons, 2.02 (6H, s, two CH_3-COO-), 5.18 (1H, dd, H-C_{11} , $J_{11,12'}$=2 cps , $J_{11,12''}$=7 cps) and 7.5 (1H, t, H-C_{14} , $J_{14,12'}$ and $J_{14,12''}$ =3 cps).

After ozonolysis of (X) in ethyl acetate at -60° and reduction of the ozonide with zinc and acetic acid , we obtained among other products, a compound identical with the unsaturated ketone (VI) in the mixed melting point, infrared spectrum , mass spectrum and optical rotation.

Since the absolute configuration of tutin has been determined (5,6), it follows that (I) represents the true configuration of capenicin. The configurations C_{11}-H , C_{12}-H and C_{13}-C_{14} are not strictly proved by the structural correlation presented in this communication; however these were previously (4) established through the examination of the resonances exhibited by the epoxide protons and by the C_{14}-methylene in the N.M.R. spectra of capenicin and of its derivatives in comparison with those of all the compounds examined by us (7).

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7) N.M.R. were determined at 60 Mc with TMS as internal reference; chemical shifts are in δ=ppm ; s= singlet or singlets, d= doublet or doublets , dd= double doublet , t= triplet and m= multiplet.