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METABOLIC PRODUCTS OF CLITOCYBE ILLUDENS IX. * STRUCTURE OF ILLUDACETALIC ACID AND ITS CONVERSION TO ILLUDININE.

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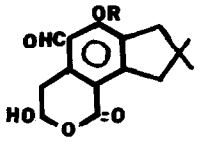
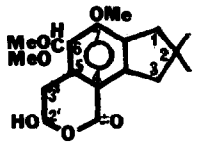
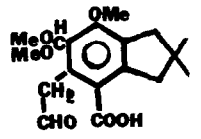
The structure of illudalic acid (I), a metabolite of Clitocybe illudens, was reported a few years ago.[1] We have now isolated, from the same strain of this Basidiomycete, a closely related metabolite to which we have assigned the structure II on the basis of the evidence presented below.



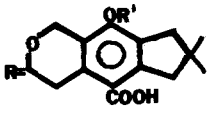
I R = H

III R = Me





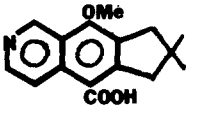
II



IV R = O, R' = Me

VI R = 

, R' = H



V

The new metabolite,** $C_{18}H_{24}O_6$ (MS, elemental analysis) "illudacetalic acid", was obtained from the least polar fractions of a countercurrent distribution, as a crystalline solid m.p. 145-7° (ETOAc). It dissolves in $NaHCO_3$ with evolution of gas; it has uv max at 280 (sh), 240 (sh) and 213 nm (ε 725, 5800, and 35400); ir max around 2700 and 2560 (two broad humps), 1685, 1600 and 1575 cm^{-1}; nmr signals at δ 1.11 (s, 3H, C2-Me) 1.16 (s, 3H, C2-Me) 2.8 (s, 2H, C1) 3.01 (s, 2H, C3) 3.25 (broad, 2H, C3') 3.6 (s, 3H, CH-OCH3) 3.63 (s, 3H, CH-OCH3) 3.9 (s, 3H, C7-OCH3) 5.1 (m, 1H C2') 5.8 (s, 1H, C6-CH).

** The method of isolation precludes the possibility that this acetal is an artefact.

On thin layer chromatography, using benzene-acetic acid as developer, decomposition occurs and a new crystalline product (III) m.p. 146-8° can be isolated. The same product is obtained by treatment of illudacetalic acid with acids under mild conditions. Its uv spectrum, max at 315, 270 (sh) and 243 nm (ε 1230, 8950, 23200) is very similar to that of I. The nmr of this product (III) differs from that of illudacetalic acid by the absence of the singlets at δ 3.6, 3.63 and 5.8 and by the presence of a singlet at δ 10.5 (non-exchangeable with D_2O), characteristic of aldehydes. Thus, the acid treatment clearly involves hydrolysis of a methylacetal. Other nmr signals δ 1.2 (s, 6H) 2.9 (s, 2H) 3.21 (s, 2H) 3.6 (broad, 2H) 4.0 (s, 3H) 5.5 (broad, 1H, exchanges with D_2O) and 5.89 (poorly resolved triplet, 1H) are indicative of structure III, the methyl ether of illudalic acid (I). In agreement, the aromatic aldehyde absorption in III appears at 1715 cm^{-1} instead of at 1648 cm^{-1}, the position for the strongly chelated aldehyde in I. Further, III, like I, undergoes a Canizzaro reaction [1] to yield the expected lactonic acid (IV), m.p. 196-8°; uv max 285 (sh) 245 and 213 nm (ε 1035, 7050, 34600); ir max 1754, 1724, 1681, 1582 cm^{-1}; nmr singlet at δ 1.16 (6H), singlets for 2H each at 2.9, 3.09, 4.15 and 5.38, another for 3H at 3.91 and a broad singlet for 1H at 7.5 (exchanges with D_2O).

In contrast to I and III, which apparently exist exclusively in the lactol form, illudacetalic acid shows a tendency to tautomerize. While it is essentially in the closed form in non-polar solvents, as evidenced by the nmr, the presence of the open form is demonstrated by the weakened hydroxyl absorption in the ir (KBr pellet) compared to that of III, as well as by absorption around 2560 cm^{-1}, characteristic of carboxylic acids. This type of tautomerism in aldehydo- and keto-acids is not uncommon,[2] but it is remarkable that the tautomerism should be suppressed in III, which differs from II only by the presence of the free aldehyde group on the aromatic ring.

Illudacetalic acid, on treatment with ammonia, is converted smoothly to illudinine (V), a metabolite produced by other strains of the same species. [1] This not only confirms the structure of II, but suggests its probable precursor relationship to illudinine. We are examining the biogenetic relationships of illudacetalic acid to illudalic acid (I) and illudoic acid (VI)[1] as well as to illudinine.

* Part VIII: Singh, P., and Anchel, M. Phytochem. 10, 3259 (1971)

1/ Nair, M.S.R., Takeshita, H., McMorris, T. C., and Anchel, M. J. Org. Chem. 34, 240 (1969)

2/ Ingold, C.K. Structure and Mechanism in Organic Chemistry, Cornell Univ. Press, Ithaca, N.Y. 1953, p. 540-543.

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