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THE STRUCTURE OF PHYSALIN C

A BITTER PRINCIPLE OF *PHYSALIS ALKEKENGI VAR. FRANCHETI*

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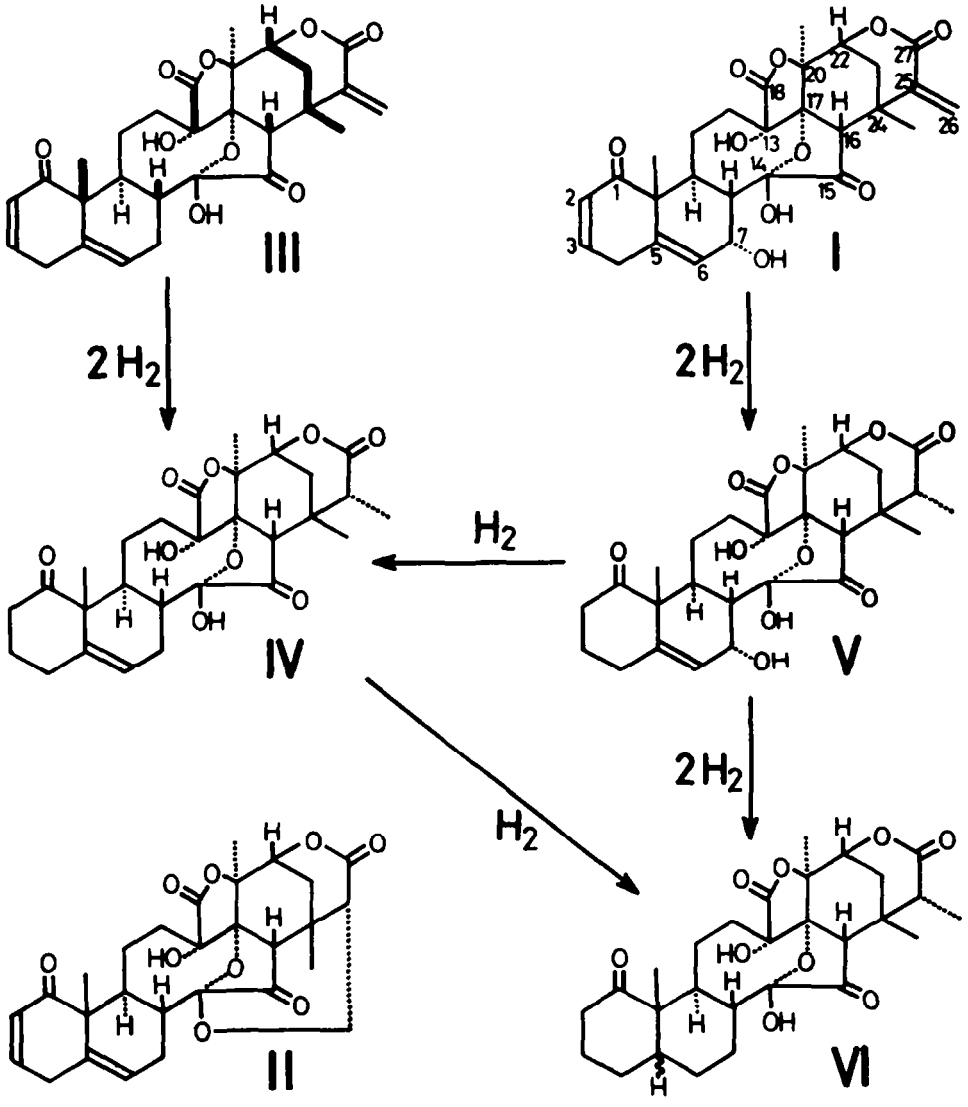
Abstract- Physalin C, a bitter principle of *Physalis Alkekengi var. Francheti,* was isolated and the structure was established as 7-deoxyphysalin A.

PHYSALIN A (I) and physalin B (II), bitter principles of *Physalis Alkekengi var. Francheti* (Japanese name; Hôzuki), were isolated and the novel 13,14-seco-16,24-cyclosteroidal structures established.[1,2] The mother liquor from recrystallization of I and II showed a spot on TLC as well as spots corresponding to I and II. The new substance was isolated from the mother liquor by column chromatography. The compound had a bitter taste and was named physalin C. In this paper the structure of physalin C is described.

Physalin C (III) ($C_{28}H_{30}O_9$) crystallized from ethyl acetate as colourless prisms. The IR spectrum of III was similar to that of I, but not to that of II. The similarity of the UV absorption spectra of I (λ_{infl} 218 mμ: ε 10000) and III (λ_{infl} 218 mμ: ε 8000) suggested the presence of the similar conjugated systems in I and III. Most of the NMR signals of III correspond to those of I and a clear difference between the spectra of I and III is that the signals of the secondary OH group in the former are not observed in the latter. Thus physalin C (III) is assumed to be a 7-deoxy-derivative of physalin A (I).

In order to confirm this assumption, III was hydrogenated with palladium-charcoal to a tetrahydro derivative. The assumed structure (IV) of the tetrahydro derivative was considered an intermediate between tetrahydrophysalin A (V) and deoxy-hexahydrophysalin A (VI), both of which were already obtained on hydrogenation of I and have been characterized.[1,2] Attempts were made to isolate deoxytetrahydro-physalin A (IV) from the hydrogenation product of I. Physlain A (I) was hydrogenated and after chromatography, gave IV, as well as V and VI. The IR spectrum of IV is identical in all respects to that of the compound obtained from III. The NMR spectrum of IV is in accordance with the assumed structure. On further hydrogenation IV gave VI, and the structure IV was established unequivocally. Consequently the correctness of the assumption concerning structure of III was confirmed. Physalin C (III) is now named 7-deoxyphysalin A or 13,14,20,22*R*-tetrahydroxy-1,15-dioxo-14α,17-epoxy-13,14-seco-16,24-cyclo-2,5,25-ergostatriene-18,27-dioic 18,20:27,22-dilactone.



EXPERIMENTAL

TLC were performed on silica gel using 10% acetone-chloroform as eluent and spots were developed with iodine vapour.

Isolation of physalin C (III). The mother liquor from recrystallization of I and II showed spots at R_f = 0·2 (I), R_f = 0·4 (III) and R_f = 0·7 (II) on TLC. The mother liquor was evaporated and the residue (2·3 g) was chromatographed on silica gel (25 g). Elution with 5% acetone-chloroform gave II (90 mg), and then elution with 8% acetone-chloroform gave 60 mg of physalin C (III), which showed one spot (R_f = 0·4) on TLC. Physalin C crystallized from EtOAc as colourless prisms, m.p. 274–277° (uncorrected); IR (KBr) 3420, 1780, 1760, 1725 and 1660 cm^{-1}; UV (EtOH) λ_{infl} 218 mμ (ε = 8000); NMR (DMSO-d_6) δ 1·07 s (t-Me), 1·55 s (t-Me), 1·80 s (t-Me), 4·55 m (22-H), 5·57 bs (26-H), 5·62 m (6-H), 5·82 bd (J = 9 c/s) (2-H), 5·90 s (t-OH), 6·13 s (t-OH), 6·39 bs (26′-H), 6·91 dm (J = 9 c/s) (3-H); $[\alpha]_D$ −160° (c = 0·145 in acetone), −154° (c = 0·10 in in EtOH). (Found: C, 64·36; H. 6·67. $C_{28}H_{30}O_9 \cdot CH_3CO_2C_2H_5$ requires: C, 64·20; H, 6·40%).

Hydrogenation of physalin A (I). Physalin A (2·4 g) in AcOH (180 ml) was hydrogenated at room temp and atm press in the presence of Pd-black (250 mg). When ca. 210 ml H_2 had been absorbed hydrogenation was stopped. The reaction mixture was treated as usual and then chromatographed on silica gel (25 g). Elution with 5% acetone-chloroform gave IV (480 mg) as an amorphous solid. Though IV could not be induced to crystallize, it showed one spot on TLC; IR (KBr) 3450, 1780, 1760, 1730 and 1700 cm^{-1}; UV (EtOH) no absorption max above 210 mμ; NMR (DMSO-d_6) δ 1·07 s (t-Me), 1·10 d (J = 8 c/s) (sec-Me), 1·42 s (t-Me), 1·74 s (t-Me), 4·45 m (22-H), 5·50 m (6-H), 6·07 s (t-OH), 6·38 s (t-OH). (Found: C, 64·28; H, 6·87. $C_{28}H_{34}O_9 \cdot \frac{1}{2}H_2O$ requires: C, 64·28; H, 6·74%).

Further elution with 15% acetone-chloroform gave VI (30 mg) and V (780 mg).

Hydrogenation of physalin C (III). Physalin C (30 mg) in EtOH (30 ml) was hydrogenated at room temp and atm press in the presence of 10% Pd-C (100 mg). The product was treated as usual and then chromatographed on silica gel (1·3 g). Elution with 7% acetone-chloroform gave the tetrahydro derivative as an amorphous solid, the IR spectrum of which was identical with that of IV obtained from I as described above.

Hydrogenation of IV. Deoxytetrahydrophysalin A (IV) (100 mg) in AcOH (40 ml) was hydrogenated for 8 hr at room temp and atm press in the presence of Pt-black (10 mg). The product was treated as usual and was recrystallized from MeOH to give VI.

REFERENCES

[1] T. Matsuura, M. Kawai, R. Nakashima and Y. Butsugan, *Tetrahedron Letters* 1083 (1969).
[2] T. Matsuura and M. Kawai, *Ibid.* 1765 (1969).