irradiation at 3.91 $\delta$ (a value compatible with CH-3′ and CH-5′) which in turn has no effect on the *d* of CH-1′. One can therefore conclude that isofusicoccin is the fusicoccin isomer carrying one acetoxy group on C-4′ (V).

The ready migration of the acetoxy group of fusicoccin from C-3′ to C-2′ and C-4′ prompted an investigation of the behaviour of the 2 isomers IV and V on incubation at pH 8.9. Thin layer chromatography showed that each isomer was interconverted into the other two. In particular IV gave at first I and later V, thus suggesting an intramolecular shift, possibly through the formation of a labile *ortho*ester. In accordance, V gave first I and later IV. Migration from C-2′ and C-3′ to C-4′ was faster than from C-4′ to C-3′ and from C-3′ to C-2′. The behaviour of fusicoccin and its isomers is paralleled by the corresponding compounds lacking the *O*-acetyl at C-19, namely monodeacetylallofusicoccin (VI) and monodeacetylisofusicoccin (VII), which are minor metabolites of *F. amygdali* to be described in a separate paper[12], and 19-monodeacetylfusicoccin (VIII), prepared by isomerization at pH 8.9 of either VI or VII. The latter compound has molecular formula $C_{34}H_{54}O_{11}$ ($M^+$ 638), is not oxidizable with periodate and after crystallization from cyclohexane-ethyl acetate has m.p. 112–114° and $[\alpha]_D^{25} + 36.6$ ($c = 0.42$). The mass spectra of VI, VII and VIII are nearly identical to each other and show, besides the parent ion, characteristic ions at *m/e* 366 (deacetylaglycone), 205 (monoacetylglucosyl), 69 ($C_5H_9^+$) and 43 ($CH_3CO^+$)[13]. Their structures are inferred from NMR- and NMDR-spectra, which yield the same type of information about the position of the acetoxy group as discussed above in the case of compounds IV and V.

Migration of the *O*-acetyl group on the glucose moiety has also been observed with the dihydroderivatives of I, IV, V, VI, VII, VIII, all prepared by catalytic hydrogenation with Pd on $BaSO_4$. Dihydrofusicoccin[2,8] and dihydroisofusicoccin[11] have already been described; the characterization of the other 4 dihydroderivatives will be reported elsewhere.

Rearrangements of acetyl groups in carbohydrates have been well known for a long time, but they usually take place under conditions stronger than those used for the above compounds. For this reason the 3 monoacetyl derivatives of methyl-6-trityl-α-D-glucopyranoside have been synthetized and submitted to the mild treatment used for fusicoccin and related compounds. Again, ready migration of the acetyl group took place[14], thus indicating that the rearrangements observed in the fusicoccin series are not influenced by the nature of the aglycone[15].

*Riassunto.* L'allofusicoccina e l'isofusicoccina, due isomeri della fusicoccina isolati dai brodi di coltura di *Fusicoccum amygdali* Del., differiscono dalla fusicoccina solamente per la posizione del gruppo acetossilico sul residuo del glucosio; nella prima questo è sul C-2′ e nella seconda sul C-4′. Fusicoccina, allofusicoccina e isofusicoccina, nonchè i loro 19-deacetilderivati ed i sei corrispondenti diidroderivati, si interconvertono a pH leggermente alcalino a temperatura ambiente.

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*5 August 1971.*

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[11] A. Ballio, A. Bottalico, M. Framondino, A. Graniti and G. Randazzo, Phytopath. Medit. *10*, 26 (1971).

[12] A. Ballio, C. G. Casinovi, M. Framondino, G. Grandolini, G. Randazzo and C. Rossi, to be published.

[13] Like fusicoccin[2,8], compound VIII gave also transacetylation ions at *m/e* 680 and 722.

[14] C. G. Casinovi, M. Framondino, G. Randazzo and F. Siani, to be published.

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## Isolation and Structure of Raucaffrinoline — A New Alkaloid from *Rauwolfia caffra* Sonder

In a reinvestigation of *Rauwolfia caffra* Sonder, an apparently new indolenine alkaloid, provisionally named raucaffrinoline, was isolated from the basic fraction of the alcoholic extractive of fresh undried root bark of the plant. Carefully avoiding any contact with strong alkali and acids or excessive heat, the alcoholic extractive was worked up in the following way: The alcoholic extracts were freed of the solvent in vacuo, the residue thus obtained was digested with hot water and distributed into aqueous and ethyl acetate layers. A small quantity of non-basic material did not go into either of these solvents and was neglected. The well cooled aqueous fraction was saturated with sodium chloride, and the water-insoluble hydrochloride formed was filtered out. The filterate was basified with 10% ammonia and repeatedly extracted with ethyl acetate. The ethyl acetate solution was washed with water, dried over anhydrous sodium sulphate and filtered. On keeping overnight, the solution gave a crystallisate which on recrystallisation from a mixture of moist ethyl acetate and methanol (5:1) yielded raucaffricine[1–3]. The mother liquor of raucaffricine was freed of the solvent in vacuo and the residue was exhaustively extracted with hot benzene. The benzene solution of the base was passed through a column of alumina (Aluminium oxide 'Woelm' activity grade I, M. Woelm-Eschweger; Fabrik Chemisch-Pharmazeutischer Präparate) and eluted with benzene which yielded perakine[4] m.p. 186–189 °C. The column was subsequently eluted with a mixture of benzene and ethyl acetate (1:1) which yielded a glassy mass on removal of the solvent in vacuo. It crystallized from methylene dichloride in prismatic rods melting at

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[1] N. H. Khan, M. Ataullah Khan and S. Siddiqui, Pakistan J. scient. ind. Res. *8*, 23 (1964).

[2] N. H. Khan, M. Ataullah Khan and S. Siddiqui, Pakistan J. scient. ind. Res. *9*, 210 (1966).

[3] M. Attaullah Khan and A. M. Ahsan, Tetrahedron Lett. *59*, 5137 (1970).

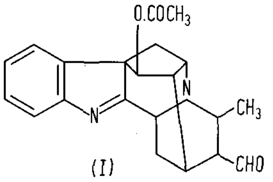
[4] A. K. Kiang and A. S. C. Wan, J. chem. Soc. *1960*, 1394.

| | Raucaffrinoline (δ) | Perakine (δ) | Nα-Demethyl-Δ' deoxy-ajmaline-O-acetate (δ) |
|---|---|---|---|
| 1 Aromatic (4 protons) | Multiplet 7.33–7.73 | Multiplet 7.20–7.75 | Multiplet 7.06–7.84 |
| 2 $C_{(3)}$–H | Distorted quartet centred at 4.20 (J=4,8) | Distorted quartet centred at 4.20 (J=4.1, 8.4) | Quartet centred at 4.20 (J=3.4, 8.8) |
| 3 $C_{(17)}$–H | Singlet 5.12 | Singlet 4.97 | Doublet centred at 5.00 (J=1.8) |
| 4 Me of *O*-Ac (3 protons) | Singlet 2.2 | Singlet 2.17 | Singlet 2.15 |
| 5 C–Me (3 protons) | Doublet centred at 1.26 (J=7) | Doublet centred at 1.29 (J=6.27) | — |
| 6 $C_{(18)}$–H aldehydic proton | — | Singlet 9.93 | — |

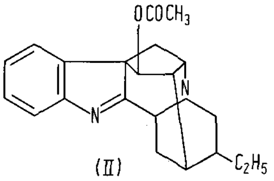
The NMR-data were obtained on deuterochloroform solutions with a varian Model HR60 spectrometer at 60 mc/sec with tetramethylsilane acting as internal standard. Chemical shifts are expressed in δ and spin-spin coupling (J) constants in cycles/second.

236 °C with decomposition and analyzed for $C_{21}H_{24}O_3N_2$. Found after drying to constant weight at room temperature over $P_2O_5$ in vacuo: C, 71.25; H, 6.73; O, 14.03; N, 8.20% and MW, 352 (mass spectrum). Calculated for $C_{21}H_{24}O_3N_2$: C, 71.57; H, 6.86; O, 13.62; N, 7.95% and MW, 352. It showed UV-absorption spectrum for indolenine derivatives ($\lambda_{\max}$. 265, 227, 220 nm, $\lambda_{\min}$. 230 nm). Its IR-spectrum shows the presence of an alcoholic –OH (3500 $cm^{-1}$) and a single peak at 1725 $cm^{-1}$ for CO against two peaks in the case of perakine accounting for $-O-\overset{O}{\overset{\|}{C}}-CH_3$ and –CHO, respectively.

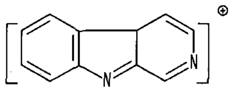
Comparison of proton magnetic spectra of raucaffrinoline, perakine[5] (I) and Nα–Demethyl–Δ'deoxyajmaline O–acetate[6] (II) revealed a close similarity in the vital regions of their spectra (Table).



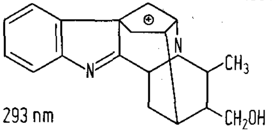
(I)



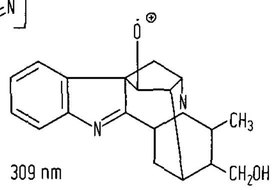
(II)



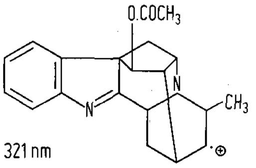
168 nm



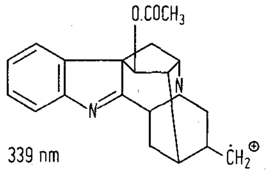
293 nm



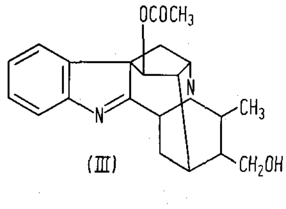
309 nm



321 nm



339 nm



(III)

The multiplet corresponding to the aromatic protons of raucaffrinoline and perakine was found almost identical in their height, shape and number of peaks. Likewise the signal associated with the protons of $C_{(3)}$-H and $C_{(17)}$-H appeared as distorted quarted centered at δ 4.20 and singlet at δ 5.12 and δ 4.97 in the NMR-spectrums of raucaffrinoline and perakine, respectively. Similarly the signals at δ 2.20 and δ 2.17 (Singlet) and δ 1.26, J = 7, and δ 1.29, J = 6.27 (Doublet centered), accounting for the acetylester methyl and C-methyl protons are almost the same in their chemical shifts and coupling constants in their spectra. Furthermore, in contrast to perakine which showed an aldehydic proton at low field, δ 9.93, it showed a singlet at δ 3.4 which may be accounted for by an alcoholic proton. Raucaffrinoline may therefore be a derivative of raucaffrine, the aldehyde group of which has been reduced to an alcoholic group.

This inference was further substantiated through mass spectral studies of raucaffrinoline. The mass spectrum showed the principal peak at 352 nm. confirming the molecular formula $C_{21}H_{24}O_3N_2$. The peak at 43 nm may be attributed to the acetyl ion ($CH_3CO^+$) whereas the peaks at 168, 293, 309, 321 and 335 nm could be accounted for by the presence of the following moieties in the raucaffrinoline molecule, respectively.

A small peak at 115 nm appears to be due to the indolenine moity or its rearrangement product.

Considering the results of micro analysis IR-, UV-, nucleomagnetic resonance, mass spectra and the probable genetic relationship with the other alkaloids of *Rauwolfia caffra* Sond., especially with perakine, the following tentative structure is proposed for raucaffrinoline (III).

*Zusammenfassung.* Ein neues Indolenin-Alkaloid aus der ungetrockneten Wurzelrinde von *Rauwolfia caffra* Sonder wurde isoliert und charakterisiert.

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[5] P. R. Ushafer, M. F. Bartlett, L. Dorfman, M. A. Gillen, E. Schlittler and E. Wenkert, Tetrahedron Lett. *11*, 365 (1961).

[6] M. F. Bartlett, J. Am. chem. Soc. *84*, 624 (1962).

[7] The authors wish to express their thanks to Dr. R. W. Hoffman of Institut für Organische Chemie der Techn. Hochschule, Darmstadt, for his help in determination of mass spectrum of raucaffrinoline.