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African Strychnos: biogenesis of the alkaloids of the usambarane group

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Chimica. — African Strychnos: *biogenesis of the alkaloids of the usambarane group.* Nota di JAMES UDËNGENE OGUAKWA (*), MARCELLO NICOLETTI (**), IRENE MESSANA (**), CORRADO GALEFFI (***) e GIOVANNI BATTISTA MARINI-BETTÒLO (**), presentata (****) dal Corrisp. G. B. MARINI-BETTÒLO.

RIASSUNTO. — Dalle radici di *Strychnos nigritana* Bak (Loganiaceae) sono stati isolati due alcaloidi terziari monomeri: la akagerina e la kribina. Viene discussa la possibile funzione di questi alcaloidi nella biogenesi delle nigritanine, alcaloidi dimeri da noi precedentemente isolati dalle foglie della stessa pianta. Gli spettri di ^{13}C-NMR della nigritanina e del O-acetil derivato della 10-idrossinigritanina ne confermano le strutture e la stereochimica.

In a previous paper [1] we reported the isolation and the structure determination of four new alkaloids, nigritanins I-IV (Fig. 1), from the leaves of *Strychnos nigritana* Bak, a plant common in Nigeria and West Africa.

These alkaloids have a dimeric structure and are formed by a corynane and a tryptamine moiety and can be considered to be derived from the condensation of corynantheale with tryptamine.

The rather complex structure of nigritanins established by us mainly on the basis of their spectroscopical data (UV, IR, ^1H-NMR and MS) has been now completely confirmed by ^{13}C-NMR spectroscopy as indicated by the values of the chemical shifts of the single carbon atoms.

Nigritanin (I)[a]: C-2, C-2′ 134.7[b], 135.5[b]; C-3 59.1; C-5 53.0; C-5′ 51.3; C-6 21.5; C-6′ 20.7; C-7, C-7′ 107.1[b], 108.8[b]; C-8, C-8′ 126.7[b], 127.0[b]; C-9, C-9′ 117.5[b], 117.7[b]; C-10 120.4; C-10′ 121.4; C-11 118.8; C-11′ 119.3; C-12, C-12′ 110.8[b], 110.9[b]; C-13, C-13′ 135.6[b], 137.7[b]; C-14 34.9; C-15 35.8; C-16 35.0; C-17 58.6; C-18 11.2; C-19 23.7; C-20 41.9; C-21 60.2; Me-N_b 42.7.

10-acetoxynigritanin (V)[a]: C-2, C-2′ 133.7[b], 135.8[b]; C-3 59.3; C-5 53.0; C-5′ 51.2; C-6 21.6; C-6′ 20.6; C-7, C-7′ 107.6[b], 108.8[b]; C-8, C-8′ 126.9[b], 127.4[b]; C-9 111.3; C-9′ 117.8; C-10 143.9; C-10′ 121.5; C-11 114.5; C-11′ 119.4; C-12, C-12′ 110.0[b], 111.2[b]; C-13, C-13′ 136.1[b], 136.7[b]; C-14 34.9; C-15 36.0; C-16 35.2; C-17 58.6; C-18 11.3; C-19 23.7; C-20 42.1; C-21 60.4; Me-N_b 42.7; *Me*-CO 21.1; C=O 170.6.

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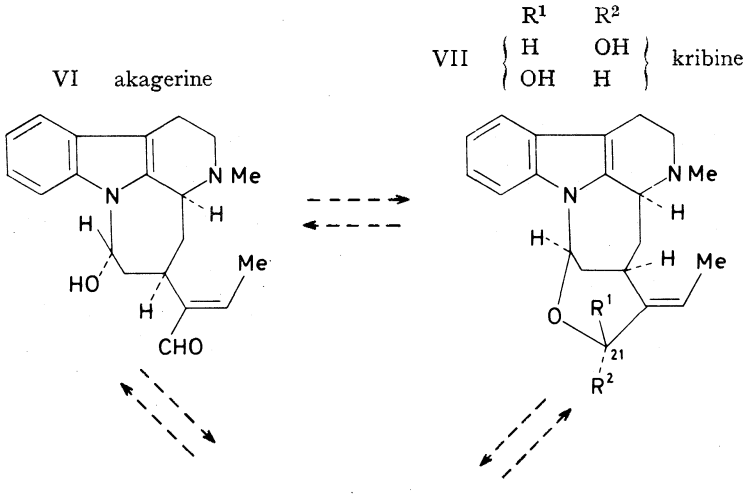
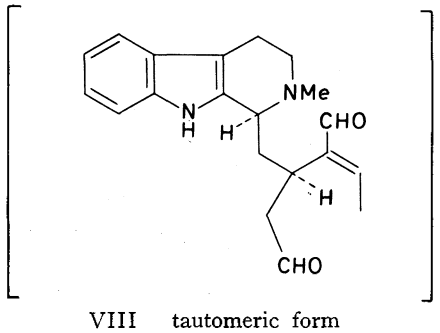
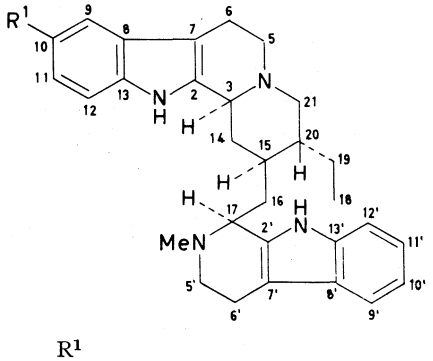
a) In ppm downfield from $Me_4Si = \delta\,(CDCl_3) + 77.0$.

b) Assignment may be reversed.





VIII tautomeric form



	R^1		
I	H		nigritanin
II	OH		10-hydroxynigritanin
III	H	Δ^{18}	18-dehydronigritanin
IV	OH	Δ^{18}	18-dehydro-10-hydroxynigritanin
V	OAc		10-acetoxynigritanin

Fig. 1.

The spectroscopical analysis of II was performed on the O–acetyl derivative of the natural product, because the spectrum of II in $CDCl_3$ is unintelligible because of the tautomery due to the presence of the hydroxy group in position 10 [2]. The analysis of the configurations and conformations on the models as well as the comparison of the data reported for ochrolifuanines [3], which have a similar skeleton, confirms the assigned stereochemistry for every chiral centre of the nigritanins.

Moreover, we have isolated from the root bark of the same plant an alkaloid, $C_{20}H_{24}N_2O_2$, m.p. 190–2° C, M^+ at m/e 324, which on the basis of its chemical and spectroscopical properties was identified with akagerine VI, isolated from *S. usambarensis* [4] and from *S. dale* and *S. eleocarpa* [5]. We have also isolated from roots of *S. nigritana* the isomer of akagerine, $C_{20}H_{24}N_2O_2$, which was identified through its spectroscopical and chemical properties as kribine VII, recently obtained from *S. dale* and *S. eleocarpa* [6]. VII was isolated as a mixture of epimers at the chiral centre C–21. It is not possible to establish whether the two epimers are both natural or whether one of them formed during the extraction by epimerization.

The contemporary occurrence of tertiary monomeric and dimeric alkaloids in *S. nigritana*, as well as in *S. usambarensis* [7], suggests some hypotheses regarding the biogenesis of these alkaloids. In effect, if we consider VI and VII in their tautomeric form VIII, we have clear evidence that this substance can react with tryptamine giving rise to the usambarane system.

Thus the intermediates VI, VII and VIII from a certain point of view have a function similar to that of W. G. aldehyde, which is also present in the aldehydic and cyclic form, in the biosynthesis of the dimeric alkaloids of the C–curarine, C–toxiferine series in American Strychnos.

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