

Tetranortriterpenoids. Part XIV.¹ The Structure of Nyaşin, a Limonoid from *Khaya nyasica*; a Correction

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Nyaşin has been shown to be 11 β -hydroxykhivorin (4) rather than an isomer of khivorin. This was confirmed by its preparation by partial hydrolysis of 11 β -acetoxykhivorin (2).

NYASIN is a limonoid which was extracted in very small amount from a sample of timber of *Khaya nyasica*.² Further specimens of the timber yielded only khivorin (1) and 11 β -acetoxykhivorin (2).³ Originally nyaşin was thought to be isomeric with khivorin and it was assigned the structure (3).^{2,3} We now present evidence which proves that this was incorrect, and that nyaşin is 11 β -hydroxykhivorin (4).[†]

Nyaşin, C₃₂H₄₂O₁₁ contains a secondary hydroxy-group in addition to the three secondary acetate systems. In the mass spectrometer, this is easily lost as water, giving an apparent molecular ion at *m/e* 584. This, miscounted as 586, was responsible for the original error.

† It has been suggested by a referee that nyaşin is an artefact of isolation. We agree that this is possible, but have no evidence to enable us to decide if it is correct.

¹ Part XIII, J. D. Connolly and R. McCrindle, *J. Chem. Soc. (C)*, 1971, 1715.

The carbinol proton appears in the n.m.r. spectrum as a multiplet, δ 4.10 at 100 MHz, but is obscured at 60 MHz. Irradiation at this frequency causes a sharp doublet (H-9) at δ 2.66 (*J* 4.5 Hz) to collapse to a singlet, and irradiation at δ 2.66 leaves the carbinol proton signal as a quartet (*J*_{obs} 8.5 Hz; after D₂O exchange). These results indicate the part structure C-CH-CH(OH)·CH₂. The remainder of the spectrum strongly suggests that nyaşin is a 1 α ,3 α ,7 α -triacetate (*cf.* khivorin⁴). This leads to the conclusion that nyaşin is 11 β -hydroxykhivorin (4).

With Jones reagent nyaşin is oxidised to the ketone (5), in the n.m.r. spectrum of which H-9 appears as a sharp singlet at δ 3.87 (*cf.* 11-oxocedrelone, δ 4.05)⁵ and

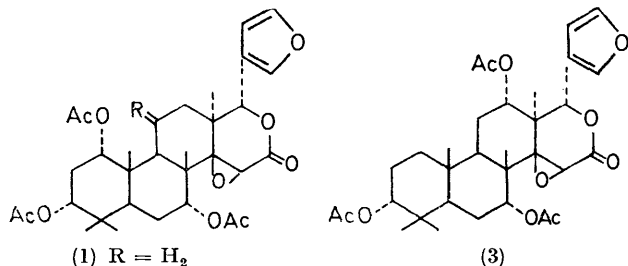
² D. A. H. Taylor, *Chem. Comm.*, 1967, 500.

³ D. A. H. Taylor, *J. Chem. Soc. (C)*, 1969, 2439.

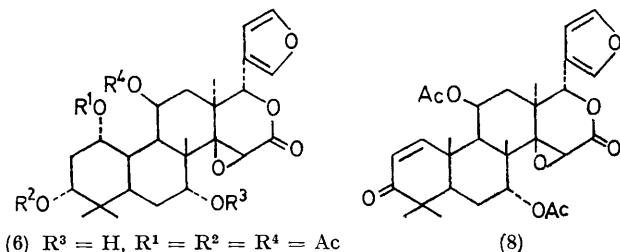
⁴ J. W. Powell, *J. Chem. Soc. (C)*, 1966, 1794.

⁵ D. A. H. Taylor, *J. Chem. Soc. (C)*, 1970, 336.

H-1 as a multiplet at δ 5.33, both being deshielded by the carbonyl group at C-11. In addition, the H-15 signal shows a slight downfield shift to δ 3.64.



- (1) R = H₂
 (2) R = H, β -OAc
 (4) R = H, β -OH
 (5) R = O



- (6) R³ = H, R¹ = R² = R⁴ = Ac
 (7) R¹ = R² = H, R³ = R⁴ = Ac
 (9) R¹ = R² = R⁴ = H, R³ = Ac

The structure of niacin was confirmed by reinvestigating the alkaline hydrolysis of 11 β -acetoxykhivorin. Previous work⁵ yielded the 7-deacetyl derivative (6) and

H-7 δ 4.48). Under more vigorous conditions of hydrolysis we confirm that the only monoacetyl product was (6); no niacin was isolated.

The presence of an 11 β -hydroxy-group in niacin readily explains the striking downfield shifts of the methyl resonances observed in its n.m.r. spectrum. Our assignments of these and the increments to the corresponding 11-deoxy-compounds are given in the Table.

EXPERIMENTAL

Nyacin.—Natural niacin crystallised from methanol as prisms, m.p. 301–303°, δ 0.76, 0.90, 1.18, 1.29, and 1.38 (tert. Me), 1.94, 1.96, and 2.06 (OAc), 3.52 (s, H-15), 4.48, 4.71, and 4.93 (each 1H, m, H-1, H-3, H-7), and 5.63 (s, H-17) (Found: C, 64.0; H, 7.2. C₃₂H₄₂O₁₁ requires C, 63.75; H, 7.0%).

Alkaline Hydrolysis of 11 β -Acetoxykhivorin.—To 11 β -acetoxykhivorin (500 mg) in methanol (70 ml) was added aqueous 0.1M-sodium hydroxide (15 ml). The mixture was refluxed for 15 min, acidified with 6M-hydrochloric acid, and extracted with chloroform. The crude product was chromatographed on preparative plates to yield starting material (90 mg), niacin (130 mg), the 1,3-dideacetyl derivative (7) (100 mg), m.p. 275–280° (from methanol), and the 7-acetate (9) (60 mg). The niacin formed prisms, m.p. 301–303° (from methanol), and was identical in all respects with the natural material. The 7-acetate was amorphous, δ 0.83, 0.87, 1.20, and 1.28 (6H) (tert. Me), 2.06 (OAc), 2.80 (1H, d, *J* 4.5 Hz, H-9), 3.58 and 3.84 (each 1H, m, H-1, H-3), 4.66 (1H, m, H-11), and 5.63 (s, H-17).

Methyl group resonances in 11-oxygenated khivorin derivatives (Hz from Me₄Si at 60 MHz; solvent deuteriochloroform)

Compound	4 α	4 β	8	10	13	Δ for	4 α	4 β	8	10	13
Nyacin (4)	46	54	77	83	71	11 β -OH	-3	-2	11	21	-5
7-Acetate (9)	50	52	77	72	77	11 β -OH	0	-1	12	22	0
7,11-Diacetate (7)	49	52	76	67	76	11 β -OAc	-1	-1	11	12	-1
11-Oxokhivorin (5)	48	56	68	88	77	11-oxo	-1	0	2	26	1

a compound now recognised as the 1,3-dideacetyl derivative (7). The latter on oxidation and treatment with acid was transformed into 11 β -acetoxygedunin (8).⁶ Under much milder basic conditions a mixture of unchanged starting material and mono-, di-, and tri-deacetyl products, separable by preparative t.l.c., was obtained. The single monoacetyl product was identical with niacin (4). The dideacetyl product was the 1,3-isomer already mentioned. The trideacetyl derivative was amorphous, but from its n.m.r. spectrum could be recognised as the 7-acetate (9) (H-15 δ 3.52;

Hydrolysis of 11 β -acetoxykhivorin under the conditions described previously gave, as before, the 7-hydroxy-compound (6) as the only monoacetyl compound. No niacin was detected.

Oxidation of Niacin.—Niacin (40 mg; from 11 β -acetoxykhivorin) in acetone (2 ml) was treated with Jones reagent (3 drops) at room temperature for 5 min. Normal work-up yielded the 11-ketone (5) (35 mg), m.p. 286–288° (from methanol), ν_{\max} (CCl₄) 1750 and 1719 cm⁻¹, δ 0.8, 0.93, 1.13, 1.28, and 1.46 (tert. Me), 1.92, 1.98, and 2.16 (OAc), 4.63 and 4.72 (each 1H, m, H-3, H-7), and 5.68 (s, H-17) (Found: C, 64.15; H, 6.8. C₃₂H₄₀O₁₁ requires C, 64.05; H, 6.7%).

⁶ J. D. Connolly, R. McCrindle, K. H. Overton, and J. Feeney, *Tetrahedron*, 1966, **22**, 891.