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(+)-AFRICANAL, A NEW LIGNAN OF THE ARYLTETRAHYDRONAPHTHALENE CLASS

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Summary: The absolute configuration (1R,2R,3R,3aS) and structural relationships of africanal, a novel lignan from *Olea africana*, are defined.

Our interest in *Olea africana* Mill (*Dicotyledoneae*), the wild olive, a species widespread on the African continent, stems from knowledge of the high resistance of its durable wood to fungal attack and the therapeutic use of its leaves amongst the local native population of Southern Africa.

The methanol extract of the heartwood gave two known lignans, (-)-olivil[1] (1, 2S,3S,4R), m.p. 126-127°C, and (+)-cyclo-olivil (2, 1R,2R,3R), m.p. 181.5-182.5°C. ^{13}C NMR data for these compounds, based on standard chemical shift theory and observed SFORD multiplicities, are presented for the first time (table 1). Acetylation (acetic anhydride/pyridine) of (+)-cyclo-olivil (2) at elevated temperature gave the novel penta-acetate (3) which enabled us to make complete NMR assignment, by means of extensive spin-spin decoupling experiments, of the cyclo-olivil skeleton for the first time (table 2).

TABLE 1

^{13}C NMR data [20.1 MHz; $(CD_3)_2CO$; δ in p.p.m. from TMS]

Lignan					C				Aromatic	OMe
	1	2	2a	3	3a	4	4a	5		
(1)		83.7		61.2	60.0	81.5	39.9	77.0	147.1-129.4 123.0-110.4	57.8
(2)	44.8	47.6	60.5	73.4	69.4	40.1			147.4-125.8 122.9-117.4	56.0
(4)	48.5	45.1	70.3	79.0	103.3	37.3			147.1-126.1 121.3-112.0	56.1

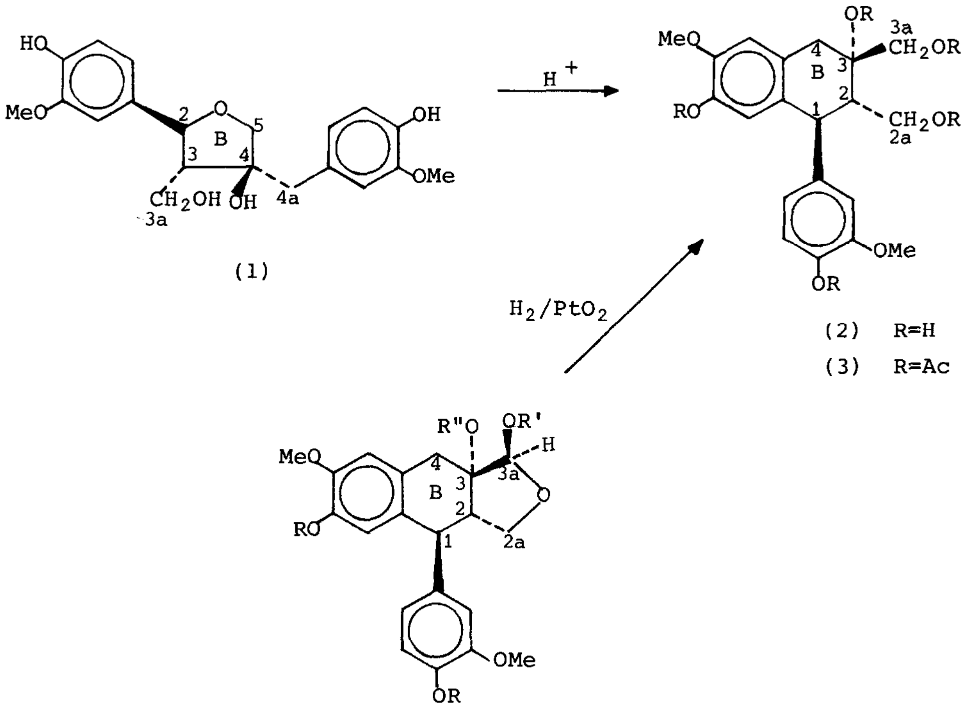
These compounds are accompanied by a novel non-crystalline compound, (+)-africanal (4), $[\alpha]_D^{25}$ + 221° (c = 0.24 in MeOH), M^+ 374 corresponding to molecular formula $C_{20}H_{22}O_7$, which proved to be the first cyclo-lignan hemiacetal, closely related to lignan acetals[2] from *Dacrydium intermedium* T. Kirk. The compound (4) was fully characterized by elemental analysis; by spectroscopic data (NMR and MS), including those of its derivatives (5) - (8); and by chemical conversion to (+)-cyclo-olivil (2). Comparison of ^{1}H and ^{13}C NMR spectra of (+)-

cyclo-olivil (2) and (+)-africanal (4) revealed their close structural resemblance.

TABLE 2

^{1}H NMR resonances (τ) and coupling constants (Hz) of non-aromatic protons of (3) and (8) (C_6D_6)

	H					
Lignan	1	2	2a	3a	4-eq.	4-ax.
(3)	5.81 d(8.75)	7.56-7.22 m	5.76,5.55 dd(5.5,11.5)	5.31,5.06 d(11.5)	6.13 d(17.25)	6.86 d(17.25)
(8)	5.77 d(12.0)	7.49-6.97 m	6.13 d(8.75)	2.80 s	5.96 d(16.25)	6.72 d(16.25)



(1)

(2) R=H

(3) R=Ac

(4) R=R'=R"=H

(5) R=Me; R'=R"=H

(6) R=R'=Me; R"=H

(7) R=R'=Ac; R"=H

(8) R=R'=R"=Ac

Hydrogenation (PtO_2) of (+)-africanal (4) under normal conditions gave conversion into (+)-cyclo-olivil (2) in high yield. Such cleavage of the hemiacetal moiety may be analogous to the reductive alkylation of alcohols developed by Verzele.[3] The conversion taken in conjunction with almost superimposable CD-spectra of (+)-cyclo-olivil (2) and (+)-africanal (4) defines the absolute stereochemistry of the latter at C_1, C_2, and C_3 (1R,2R, 3R), but not at C_{3a}. Large deshielding ($\Delta\tau$ 1.14) of the C_{3a}-proton in NMR spectrum of the tetra-acetyl derivative (8) in comparison with that of (7), however, strongly indicates a β-*axial*-orientation and S-configuration of the C_{3a}-hydroxyl group.

Methylation with diazomethane gave the tetramethylether (5) as well as the pentamethyl derivative (6), the latter presumably due to enhancement of acidity of the C_{3a}-hydroxylic proton by adjacent heterocyclic oxygen. Close structural resemblance of the three lignans was also verified by the well-known stereospecific acid-catalysed conversion[4] of (-)-olivil (1) to (+)-cyclo-olivil (2).

(+)-Africanal apparently provides a novel link in the biogenetic sequence of oxidation level of ring-B within the aryltetrahydronaphthalene group of lignans. Its biosynthetic origin is speculatively envisaged as lactonisation of an intermediate C_3-aldehyde following selective oxidation preferentially at the glycol unit of (+)-cyclo-olivil. Considering that biological activity is associated with the B-ring of cyclo-lignans, exceptionally high resistance of the wood of *Olea africana* against microbial decay might well be attributed to presence of at least (2) and (4). These lignans are accompanied by two glucosides of unknown constitution, and together these will be the subject of full publication.

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