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ISOLATION, STRUCTURE AND STEREOCHEMISTRY OF APHANAMIXIN - A NEW TRITERPENE FROM APHANAMIXIS POLYSTACHYA WALL AND PARKER

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In recent years much interest has been centered around the family Meliaceae which has been found to produce a number of tetranor-triterpenoids (C_{26}-unit)[1,2] with ABCD rings intact[3] or with a cleavage of ring B[4] or C[5]. These C_{26}-terpenoids with uncleaved ABCD ring system presumably arise from euphol or butyrospermol by Baeyer Villiger oxidation of ring D with simultaneous oxidation at the side-chain followed by the appropriate cyclisation to β-substituted furan with the elimination of C_4-unit. An interesting tetracyclic triterpene with a hemiacetal system which may be considered as an intermediate between butyrospermol and tetranorterpenoids (C_{26}-unit) has been isolated from a meliaceous species Aphanamixis polystachya Wall and Parker (Syn. Amoora rohituka). This Meliaceae plant grows luxuriantly in Bengal and its fruits taste extremely bitter. The fruits after the removal of bitter oil are generally used as fertilisers.

From the petrol extract of the bitter fruit-shell the aforesaid new triterpene designated as aphanamixin has been isolated and it has been purified by chromatography over Brockmann alumina using petrol ether and benzene:chloroform mixture (1:1) as the eluents. Aphanamixin migrated out of the column with the latter solvent mixture and gave stellate crystals from methanol. The elemental analysis and the mass spectrometrically

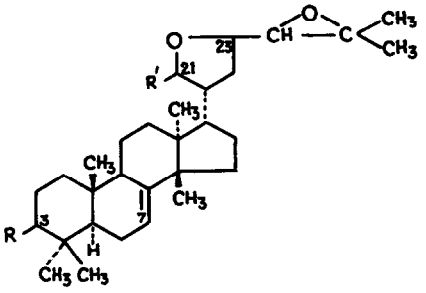
derived molecular weight (M^+ 514) of the compound establish its molecular formula as $C_{32}H_{50}O_5$*.

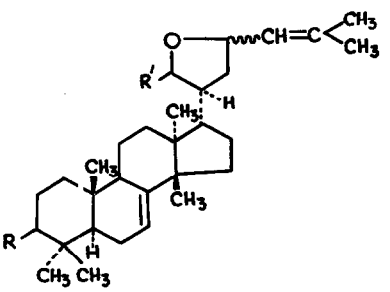
Aphanamixin (I), m.p. 232-34°, $[\alpha]_D^{26}$ -45° gives positive Liebermann-Burchard reaction and contains a free hydroxyl (3380 cm^{-1}) and an acetoxy function (-OCOCH$_3$) (1720, 1260 cm^{-1}; methyl singlet at 2.06 δ). The hydroxyl group in aphanamixin is acylable [acetate (Ia), $C_{34}H_{52}O_6$, m.p. 128-30°, (1740, 1248 cm^{-1})] and is associated with a five-membered hemiacetal system (-O-CHOH-) as is evident from its oxidation with chromium trioxide-pyridine to a 5-membered ring lactone (Ib), $C_{32}H_{48}O_5$ (M^+ 512; 1785 cm^{-1}, no OH absorption). The fifth oxygen atom in aphanamixin is relatively inert and probably occurs as an epoxy group as a part of $Me_2C\overset{O}{\frown}CH$- system (six proton singlet at 1.31 δ, one proton doublet centered around 2.85 δ, J = 8.5 c.p.s).

The positive tetranitromethane colour reaction, the infrared spectral band at 1640 and 825 cm^{-1} and the olefinic proton signal at 5.28 δ suggest the presence of a trisubstituted double bond (>C=CH) which, in all probability, resides within a ring as on ozonolysis it does not afford any detachable fragment. In the olefinic proton region, another one proton signal appears. This is attributed to the methine proton (-O-C<u>H</u>-OH) of the lactol group. This is the correct presumption as observed from the absence of this -C<u>H</u> proton signal in the n.m.r. spectrum of the γ-lactone, the CrO_5 oxidation product of aphanamixin. Selenium dehydrogenation of aphanamixin produced 1,2,8-trimethylphenanthrene, m.p. 144-46°, characterised as its picrate, m.p. 164-65° and identified by comparison with an authentic sample. This degradative experiment conjointly with the spectroscopic data and other physical and chemical properties of the compound provide a good document for relating it to tirucalla-7,24-dien-

*Satisfactory elemental analyses were obtained for all compounds cited in this communication.

3β-ol thereby suggesting its structure as (I). The latter can explain all the salient features of the compound and is in consonance with its n.m.r. spectral analysis (Table I).





I : R = H, β-OAc; R' = H, β-OH

Ia : R = H, β-OAc; R' = H, β-OAc

Ib : R = H, β-OAc; R' = O

Ic : R = O; R' = H, α-OH

Id : R = H, β-OAc; R' = H, ξ-OH

II : R = H, α-OH; R' = H, α-OH

TABLE I

NMR spectral data for Aphanamixin*

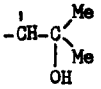
Chemical shifts in ppm (δ)	Splitting pattern**	Number of protons	Assignment of protons
5.28	m	2	C-7 and C-21
4.66	t	1	C-3
3.86	m	1	C-23
3.24	s	1	C_{21}-OH
2.85	d (J=8.5 c/s)	1	C-24
2.06	s	3	C_3-O.C.CH_3 (O)
1.31	s	6	C-26 and C-27
0.78-1.00	singlets	15	C-18, C-19, C-28, C-29 and C-30

* Taken in $CDCl_3$ on a 60 Mc NMR Spectrometer with tetramethylsilane as internal standard.

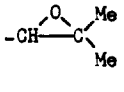
**m = multiplet; t = triplet; d = doublet; s = singlet.

Signals are found in the n.m.r. (60 Mc/sec.) spectrum of aphanamixin (Table I) at δ 5.28 (2H at C-7 and C-21), 4.66 (1H at C-3), 3.86 (1H multiplet at C-23), 3.24 (1H in OH), 2.85 (doublet) (1H at C-24), 2.06 ($-O-CO-CH_3$), 1.31 (2Me) and 0.78-1.00 (5Me). The methyl peaks are singlets. On refluxing with D_2O the signal at δ 3.24 disappeared indicating the presence of only one OH group. The peak at δ 4.66 is due to the proton at C-3 bearing the acetoxy function. The chemical shifts of C-3 proton and acetoxy function are typical of 3α-proton of triterpene-3β-acetates. Aphanamixin shows a doublet at δ 2.85 (J = 8.5 c/s) due to a proton on a carbon bearing oxygen (epoxy ring). This together with the absorption of two methyl groups at δ 1.31 suggests the presence of the group $-CH-CH(O)CMe_2$, chemical evidence of which was provided by CrO_3 oxidation of aphanamixin in glacial acetic acid. The latter produced acetone which may arise from (a),(b),(c).

(a)



(b)



(c)

In view of the absence of an end isopropylidene group (n.m.r. data and ozonolysis experiment) and of the occurrence of only one -OH as -O-CHOH in the compound, aphanamixin must have the α-oxirane functionality (c).

Convincing evidence for the location of double bond at C-7 was adduced from the formation of a 7,9(11)-heteroannular diene[6,7] which is characteristic for a butyrospermol type skeleton[6] and thereby sets the stereochemistry of the ring ABCD in aphanamixin.

It is, therefore, a close relative of flindissol (II)[8] isolated from Flindersia dissosperma Domin (Rutaceae) and of melianone (Ic)[6,7] from Melia azedarach Linn. (Meliaceae). Turraeanthin (Id)[9], $C_{32}H_{50}O_5$, m.p. 218-20°, $[\alpha]_D$ +3°, isolated from Turraeanthus africanus of the same family Meliaceae possesses the structure as that of aphanamixin (I) but their physical

properties (m.p., specific rotation) were found to differ (mixture m.p. 205°). With a view to ascertaining whether they differ in stereochemistry a comparative study of these two compounds was made. It was observed that the lactone derivatives $C_{32}H_{48}O_5$ (M^+ 512) of both aphanamixin and turraeanthin melted at 180-82°. They were found to be identical in every respect (m.p., m.m.p., TLC and superimposable i.r. spectra). It was further observed that melianone is 3-oxo-desacetyl C_{21}-epi aphanamixin. It is, therefore, firmly established that aphanamixin and turraeanthin are C-21 epimers.

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