Tetrahedron Letters No. 39, pp 3559 - 3562, 1976. Pergamon Press. Printed in Great Britain.

THE STRUCTURE OF POLYALTHENOL, AN INDOLOSESQUITERPENE

Michel LEBOEUF, Michèle HAMONNIÈRE and André CAVÉ,
Laboratoire de Matière Médicale, UER de Chimie Thérapeutique
Centre d'Etudes Pharmaceutiques - 92290 CHATENAY-MALABRY, France

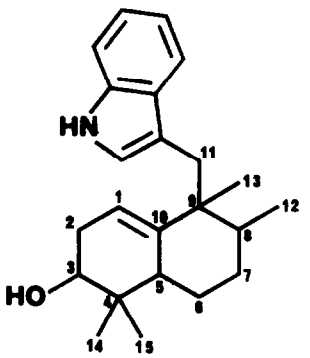
Hugo E. GOTTLIEB, Nicole KUNESCH and Ernest WENKERT,
Department of Chemistry, Rice University, HOUSTON, Texas 77001, U.S.A.

(Received in UK 22 July 1976; accepted for publication 9 August 1976)

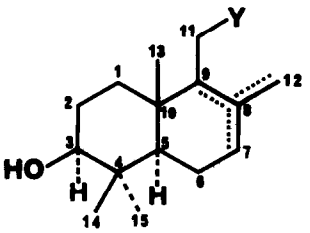
The tropical African plant Polyalthia oliveri Engl. has yielded aporphine alkaloids[1,2], the new triterpene polycarpol[3] and a nitrogenous compound of new structure type, now named polyalthenol. The latter, mp 149-150°, $[\alpha]_D$+50° (c = 0.4, EtOH), m/e 337, is a $C_{23}H_{31}ON$ compound whose UV [λ_{max}^{EtOH} 226 nm (log ε 4.52), 285 (3.76), 292 (3.73)] and mass spectra [m/e 130 (100%), 189 (M-130-H_2O)] show it to be indolic and sesquiterpenic [m/e 207 ($C_{15}H_{25}O$)] and whose ^{1}H NMR spectrum reveals the attachment of the two structure units to involve the indole β-carbon [δ 6.74 (m, 1, indole α-H)] and a neopentyl methylene of the terpene moiety [2.61, 2.75, 2.82, 2.96 (AB dd, 2, J = 14 Hz, CH_2)].

The ^{1}H NMR spectrum of polyalthenol also exhibits five indole hydrogens [7.0-7.6 (m, 4, methines), 7.94 (broad s, 1, NH)], four methyl groups [0.78, 0.99, 0.99 (s, 3 each), 1.10 (d, 3, J = 6 Hz)], an axial oxymethine hydrogen [3.31 (t, 1, J = 7 Hz)], an olefinic hydrogen [4.93 (broad t, 1, J = 4 Hz)] and two allylic hydrogens [1.96 (dd, 2, J = 7,4 Hz)]. The last four hydrogens possess a $R_3CCH(OR')CH_2CH{=}CR''_2$ relationship, since irradiation of the 1.96 ppm methylene signal causes collapse of the 3.31 and 4.93 ppm triplets into singlets. The oxygen is part of an equatorial, secondary alcohol moiety as indicated by the deshielding of the oxymethine [4.65 (t, 1, J = 7 Hz)] on acetylation of polyalthenol. The simultaneous shift change of two methyl singlets (0.78, 0.99 → 0.85, 0.88 ppm) without other shift alteration suggests that the oxygen of the homoallyl alcohol is in close proximity to two methyl groups on a quaternary carbon site, e.g. as in $Me_2CRCHOHCH_2CH{=}CR'_2$.

A ^{13}C NMR analysis of polyalthenol[4] confirms the presence of a β-substituted indole[5], a trisubstituted double bond, an oxymethine, an allylic methylene, a benzylic methylene and a quaternary carbon center. Furthermore, it reveals another quaternary carbon on which must reside the remaining methyl group characterized by a singlet in the ^{1}H NMR spectrum (vide supra). Since the sford[a] spectra indicate residual coupling related to an allylic methine and signal breadth of the second quaternary carbon site characteristic of three-bond coupling with the olefinic hydrogen, the homoallyl alcohol unit may be expanded to encompass the following structure pattern : $Me_2CRCHOHCH_2CH=C(CHR'_2)CMeR''_2$. Transfer of the latter onto a biogenetic basis leads to structure 1 as a possible representation of the natural product, on the assumption of a drimanic pyrophosphate (2) having trapped tryptophan (with extrusion of dehydroalanine or serine) and the resultant indolosesquiterpene having undergone acid-catalyzed rearrangement.



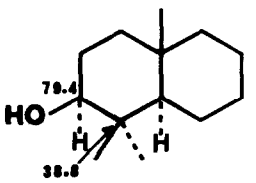
1



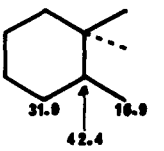
2

Comparison of the δ values of the oxymethine and its neighboring quaternary center with those of like carbon sites of decalol 3[6] reveals the requisite endocyclic homoallyl effect[7], while the chemical shifts of C(7), C(8) and C(12) are very similar to those of like substitution sites of 1,1,2-trimethylcyclohexane (4)[8]. These facts as well as the similarity of calculated and observed shifts (cf. 5) of other carbon centers of polyalthenol are in accord with structure 1. Finally, $Eu(dpm)_3$-induced ^{1}H shift and $Yb(dpm)_3$-induced ^{13}C shift studies confirm the gross structure and aid in the determination of the relative stereochemistry. As the Δδ values for 1:1 molar ratios of 5 : $Yb(dpm)_3$, depicted on formula 6, indicate, in the presence of an equatorial hydroxy group (vide supra) and on the assumption of the octalin skeleton maintaining a half-chair/chair conformation, stereostructure 5 (6) represents the structurally novel indolosesquiterpene[9].

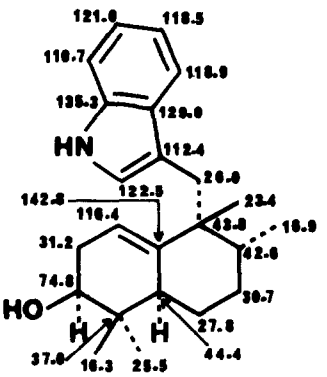
a - 'single frequency off resonance decoupled'



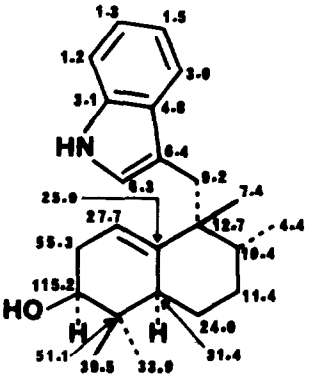
3



4



5



6

REFERENCES

1 . M. HAMONNIÈRE, M. LEBOEUF, and A. CAVÉ,
C.R. Acad. Sc. Paris (C), 278, 921 (1974).

2 . M. HAMONNIÈRE, M. LEBOEUF, and A. CAVÉ,
Phytochemistry, in press.

3 . M. HAMONNIÈRE, A. FOURNET, M. LEBOEUF, A. BOUQUET, and A. CAVÉ,
C.R. Acad. Sc. Paris (C), in press.

4 . Carbon-13 Nuclear Magnetic Resonance Spectroscopy of Naturally Occuring Substances. LII. For the preceding publication see R.J. WESTON, H.E. GOTTLIEB, E.W. HAGAMAN and E. WENKERT, Aust. J. Chem., in press.

5 . R.G. PARKER and J.D. ROBERTS,
J. Org. Chem., 35, 996 (1970) ;
G.W. GRIBBLE, R.B. NELSON, J.L. JOHNSON, and G.C. LEVY,
ibid., 40, 3720 (1975).

6 . B.L. BUCKWALTER, I.R. BURFITT, A.A. NAGEL, E. WENKERT, and F. NÄF, Helv. Chim. Acta, 58, 1567 (1975).

7 . E. WENKERT, J.S. BINDRA, C.-J. CHANG, D.W. COCHRAN, and F.M. SCHELL, Accounts Chem. Res., 7, 46 (1974).

8 . D.K. DALLING and D.M. GRANT, J. Amer. Chem. Soc., 89, 6612 (1967).

9 . N.K. expresses her gratitude for a 1975-1976 fellowship under the Centre National de la Recherche Scientifique (France) - National Science Foundation (U.S.A.) scientific exchange program.