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THREE NEW FRIEDELANE LACTONES FROM THE BARK OF GYNOCARDIA ODORATA (FLACOURTIACEAE)

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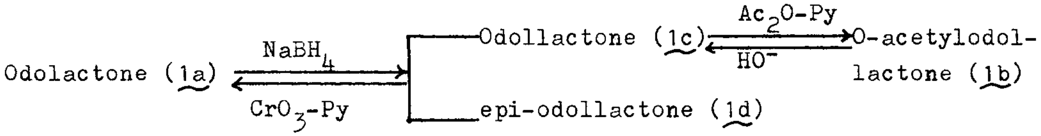
Three new triterpenes - odolactone, acetylodollactone and odollactone from the bark of Gynocardia odorata have been characterised as 3-keto, 3α-O-acetyl and 3α-hydroxyl derivatives of friedelan-26⟶12β-lactone respectively.

The benzene extract of the bark of Gynocardia odorata R. Br.[1] on chromatographic separation yielded odolactone (1a), O-acetylodollactone (1b) and odollactone (1c). Elemental analysis and mass spectrum of 1a showed the molecular formula $C_{30}H_{46}O_3$ (M^+ 454), m.p. 304-05°#, $[\alpha]_D^{CHCl_3}$ -47.06°, IR showed the presence of a saturated six membered ring ketone and a γ-lactone at 1720 and 1760 cm^{-1} respectively. 1b had the molecular formula $C_{32}H_{50}O_4$, m.p. 302-03°, $[\alpha]_D^{CHCl_3}$ -19°, the IR bands at 1760 cm^{-1} showed the presence of γ-lactone and 1725 and 1240 cm^{-1} indicated an acetyl group; 1c was analysed for $C_{30}H_{48}O_3$, m.p. 303-04°, its IR bands at 3490 and 1750 cm^{-1} indicated the presence of a hydroxyl group and a γ-lactone ring respectively. They were inter-related as shown in the Table below:

Table

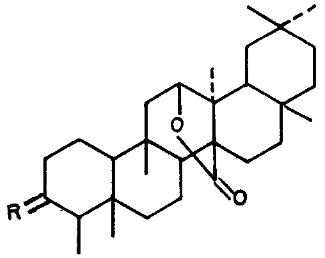


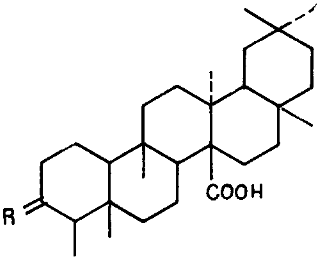
All the three compounds gave negative TNM test showing the absence of a double bond. ^1H NMR of 1a showed the presence of a secondary methyl at δ0.87 as a doublet (J = 6 Hz), six tertiary methyls at δ0.73, 0.88, 0.96, 0.98, 1.02 and 1.16 as singlets, a proton centered at δ2.4 and two protons at δ2.26 as multiplets. These observations suggested that the compound 1a possesses the friedelane skeleton. The keto group at the C-3 position was confirmed by the appearance of a methyl at δ 6.8 in the ^{13}C NMR which was due to the methyl at the C-4 position[2] and the large negative Cotton effect ($\Delta\varepsilon$ -2.24) in the CD of 1a at 289 nm.

A comparison of the chemical shifts of methyl groups of 1a and that of friedelane derivatives[3] suggested that the C-26 carbon is present as the lactone carbonyl. In the ^{1}H NMR of 1a (and also of 1b and 1c) there was a triplet centered at δ 4.38 (J = 3 Hz) corresponding to a single proton attached to the carbon bearing the lactonic oxygen. The low coupling constant showed that the proton is equatorial with one axial and one equatorial neighbouring protons, the lactonic oxygen being axial. Considering C-26 as the lactone carbonyl, such a situation is found if the lactonic oxygen is attached either at C-12 or C-16 to form a γ-lactone. The high resolution ^{1}H NMR (XL-300) of all the three compounds showed two protons at δ 1.76 and 1.85 which couple with each other with a geminal coupling constant (J = 13.4 Hz) and couple with small couplings (J = 2-3 Hz) to an equatorial proton on the carbon with the lactonic oxygen. The peaks of these protons were slightly broadened due to coupling with a nearby axial methyl. These observations suggested that the γ-lactone is formed with C-12, the α-methylene protons on C-11 having such an axial methyl at C-9, whereas the protons on C-15 do not. Thus structure 1a was proposed for odolactone.

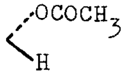
The multiplet at δ 3.3 exihibiting large couplings ($W_{\frac{1}{2}}$ = 18 Hz) showed that odollactone possessed an equatorially oriented hydroxyl group at C-3. This was proved by NaBH$_4$ reduction of 1a which afforded two hydroxyl lactones. One that was more polar was identical with odollactone (1c). Acetylation of 1c with Py-Ac$_2$O furnished an acetate identical with acetylodollactone (1b).

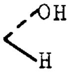
That the lactone carbonyl group is the C-26 has unequivocally been proved by converting (i) odollactone to trichadenic acid[4] (2a), (ii) acetylodollactone to 2a and deoxytrichadenic acid[4] (2b) and (iii) and odolactone to trichadenic acid B[4] (2c) with the help of ethylene diamine-Li under nitrogen atmosphere[5]. The reagent - lithium dissolved in ethylene diamine has been used for the first time to open a lactone ring giving a saturated acid. All the three lactones resisted ring opening both with acids and alkali in alcoholic solutions suggesting that the lactone ring is sterically hindered by the methyl group axially oriented at C-9 and the three hydrogen atoms at C-7, C-16 and C-18 positions which are on the same side as the lactone ring. The easy formation of carboxylic acids (100%) when reduced with Li-(CH$_2$NH$_2$)$_2$ confirmed such an environment.

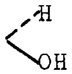


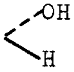


1a, R = O

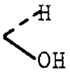
1b, R = 

1c, R = 

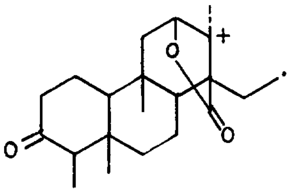
1d, R = 

2a, R = 

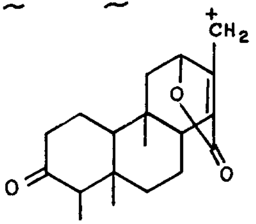
2b, R = H_2

2c, R = 

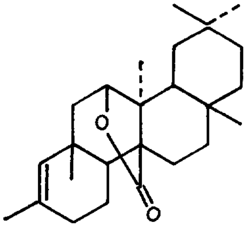
The APT[6] of odolactone showed the presence of 2 $-\overset{|}{C}=O$, 1 $-\overset{H}{\underset{|}{C}}-O$, 6 $-\overset{|}{\underset{|}{C}}-$, 4 $-\overset{H}{\underset{|}{C}}-$, 10 $-\overset{|}{C}H_2$ and 7 $-CH_3$ in conformity with the structure 1a. The existence of the fragments a and b in the mass spectrum of 1a and the common fragments c, d, e and f[7] in the spectra of 1a, 1b and 1c further supported the proposed structure.



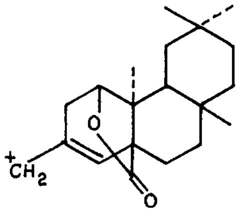
a, m/e 330 (5%)



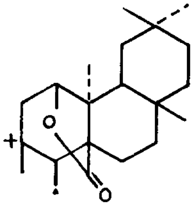
b, m/e 301 (15%)



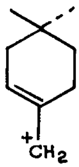
c, m/e 370 (70%)



d, m/e 301



e, m/e 316 (30%)



f, m/e 123 (100%)

It may be mentioned that this is the first report on the isolation of lactones belonging to the friedelane skeleton. That these lactones are not the artifacts of their corresponding hydroxy acids has conclusively been proved by isolating odolactone directly from the benzene extract without treatment with acid/alkali solution : on removal of the solvent under reduced pressure the residue was extracted with ether and the ether insoluble portion on repeated crystallisations from $CHCl_3$-MeOH furnished pure odolactone.

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References:

1. R. N. Chopra, S. L. Nayar and I. C. Chopra, "Glossary of Indian Medicinal Plants", CSIR, New Delhi, 129, 1956.
2. A. A. L. Gunatilaka, N. P. D. Nanayakkara, M. U. S. Sultanbawa and M. I. M. Wazeer, Org. Magn. Reson., 14, 415, 1980.
3. A. S. R. Anjaneyulu and M. N. Rao, Phytochemistry, 19, 1163, 1980.
4. S. P. Gunasekera and M. U. S. Sultanbawa, J. C. S. Perkin I, 483, 1977.
5. Reduction was carried out by heating a mixture of the triterpenoid lactone (100 mg), lithium (100 mg) and dry ethylene diamine (30 ml) under reflux in an atmosphere of nitrogen for 2 hr. The reaction mixture cooled, treated with solid ammonium chloride and then acidified with dil. HCl. The mixture on extraction with ether furnished pure triterpenoid acid.
6. (a) Le Cocq and J. -Y. Lallemend, Chem. Commun., 150, 1981.
   (b) J. N. Shoolery and S. Patt, J. Magn. Reson., 535, 1982.
7. (a) J. S. Shanon, J. G. Macdonald and J. L. Courtney, Tetrahedron Letters, 173, 1963.
   (b) H. Budzinkiewicz, J. M. Wilson and C. Djerassi, J. Am. Chem. Soc., 85, 3688, 1963.

\# M.ps were recorded in metal block.

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