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LANSIC ACID, A BICYCLIC TRITERPENE

A. K. Kiang, E. L. Tan, F. Y. Lim

(Department of Chemistry, University of Singapore)

K. Habaguchi and K. Nakanishi

(Department of Chemistry, Tohoku University, Sendai)

L. Fachan and G. Ourisson

(Laboratoire Associé au CNRS, Institut de Chimie, 67 Strasbourg)

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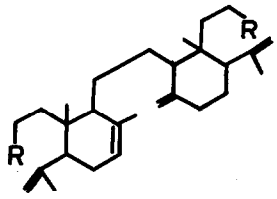
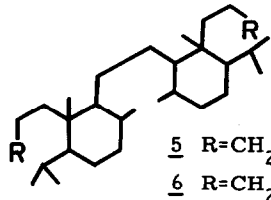
Lansium domesticum is a tree belonging to the family Meliaceae. The fruit, known locally in Malaysia as DUKU, is edible and comes from an improved race of the plant. The light petroleum extract of the peel of the fruit afforded a new triterpenoid acid, which we name lansic acid 1, $C_{30}H_{46}O_4$ (M^+ at 470), m. p. 182-184°, $[\alpha]_D$-7° (in $CHCl_3$), IR (KBr) 1725, 1645 and 890 cm^{-1}, 4 kg of dried peel gave 34 g of crude crystals.

The acid is found to be dibasic by electromeric titration. Reaction with diazomethane afforded the dimethyl ester 2[1], and reduction with lithium aluminum hydride gave the diol 3, m. p. 147-148°, $[\alpha]_D$+80.5° (in $CHCl_3$), which upon acetylation yielded the diacetate 4, m. p. 54-55°, $[\alpha]_D$+52.3° (in $CHCl_3$). Hydrogenation of the diol gave the octahydro diol 5, m. p. 135°, which was further converted to the corresponding diacetate 6. Spectroscopic studies of these compounds lead to structure 1 for lansic acid.

The 100 Mc NMR spectrum (in C_6H_6) of the methyl ester 2 showed signals attributable to: two tertiary methyls at 0.73 and 0.81 ppm; three olefinic methyls at 1.66, 1.68 and 1.76 ppm (see Fig. 2); two methoxycarbonyl methyls at 3.51 and 3.50 ppm; and seven olefinic protons at 4.65-4.95 (6H) and 5.34 ppm (br, s, 1H). Irradiation at 1.68 ppm (in C_6H_6) caused the six olefinic protons to be decoupled from the allylic protons as well as the olefinic methyl groups, so that the complex signal around 4.8 ppm arising from six protons was reduced to three pairs of doublets, thus suggesting the presence of the three moieties 8—10 (Figs. 1 and 2).



1 R=COOH
2 R=COOMe
3 R=CH_2OH
4 R=CH_2OAc
7 R=CD_2OH



5 R=CH_2OH
6 R=CH_2OAc

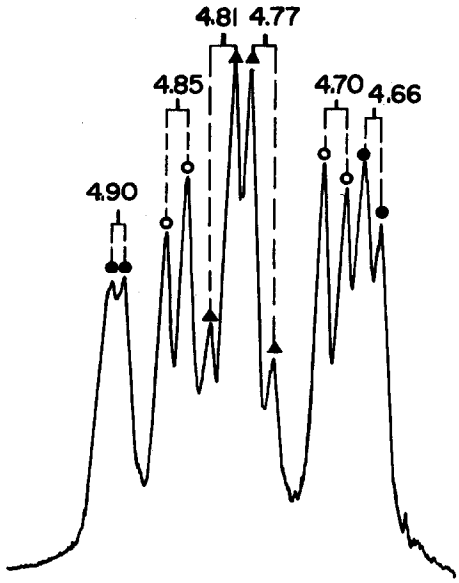
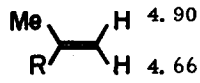
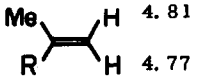
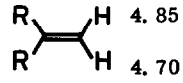


FIG. 1. The 4.65-4.95 ppm region of dimethyl lansate 2 upon irradiation at 1.68 ppm (100 Mc, in C_6H_6).

8 1.66  4.90 4.66 (d, J 1.5)

9 1.68  4.81 4.77 (d, J 2.2)

10  4.85 4.70 (d, J 2.2)

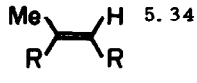
11 1.76  5.34 (br. s)

FIG. 2. Olefinic moieties of dimethyl lansate 2 as derived from the 100 Mc NMR spectrum with decoupling (in C_6H_6) (ppm from internal TMS).

Moreover, irradiation of the 1.76 ppm methyl signal converted the broad olefinic peak at 5.34 ppm (1H) to a singlet, thus indicating the presence of grouping 11.

The partial structures were supported by the NMR spectra of other lansic acid derivatives; for example, the spectrum (in $CDCl_3$) of the octahydro diol 5 showed: two pairs of isopropyl doublets (centered at 0.87 and 0.77 ppm, both with J 6.6 cps), two secondary methyl doublets (centered at 0.73 ppm, J 6.1 cps, and 0.89 ppm, J 7.5 cps, respectively), two tertiary methyl singlets (overlapping at 0.74 ppm), and a broad four proton multiplet (centered at 3.50 ppm, carbinyl CH_2).

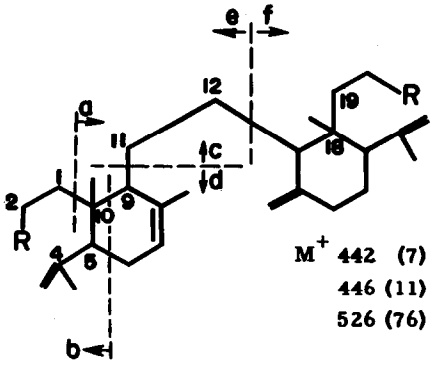


FIG. 3.

Fragmentations of the diol 3 (R=CH_2OH), diol-d_4 7 (R=CD_2OH) and acetate 4 (R=CH_2OAc).

The numerals, indicating the m/e of fragment ions, are given in the order of the diol, diol-d_4 and diol diacetate. Numerals in parentheses indicate % intensity relative to base peak. Wavy lines denote further cleavage. Asterisks after m/e numerals indicate that decomposition of the asterisked fragment leading to the succeeding fragment has been confirmed by metastable peaks.

(a)‡ 383 (7)
385 (13)
425 (32)

9 ⟩ 11 → (g) 148 (10)
148 (15)
148* (9)

4 ⟩ 5 → (h) 107 (100)
107 (94)
107 (70)

-H_2O, D_2O, AcOH → (i) 122 (3)
122 (19)
122 (35)

(b) 140 (36)
142 (64)
182 (1)

-R → (j) 109 (99)
109 (100)
109 (34)

1 ⟩ 2 → (k) 95 (63)
95 (54)
95 (40)

(c) 235 (3)
237 (5)
277 (88)

11 ⟩ 12 -H → (l) 220 (12)
222 (21)
262* (12)

18 ⟩ 19 → (m) 161 (33)
161 (42)
161 (33)

-H → (n) 234 (10)
236 (17)
276 (7)

(d) 207 (6)
209 (10)
249 (3)

1 ⟩ 10 → (g)

(e-1) 234 (10)
236 (17)
276* (7)

1 ⟩ 10 → (o) 175 (14)
175 (18)
175 (12)

(f+1) 208 (2)
210 (6)
250 (1)

18 ⟩ 19 → (p) 149 (13)
149 (24)
149 (100)

‡ Cleavage between C_{18}-C_{19} also affords fragment (a).

In summary, lansic acid contains two carboxylic groups, two tertiary methyl groups, three olefinic methyl groups, and three terminal methylene groups (8–10), i. e., a total of ten terminal groups, and should be bicyclic. These results, coupled with biogenetic considerations led to structure 1, which was fully corroborated by the mass spectra of compounds 1–6, and diol-d_4 7, m. p. 146°, the lithium aluminum deuteride reduction product of the acid. The fragmentation patterns of the diols 3 and 7, and the diacetate 4, depicted in Fig. 3 as examples, are self-explanatory and follow the general pattern reported by Enzell, et al. [2].

Lansic acid may thus be considered to be a variant of the onocerin group of triterpenes [3,4,5] in which both rings A and E have undergone cleavage of the type encountered in ring A of dammarenolic acid and nyctanthic acid [6]. The unique lansic acid skeleton formed by double cleavage of an onocerin type triterpene has not yet been found in natural products. The unsymmetrical arrangement of double bonds in rings B and D should also be noted. Clarification of the stereochemistry is in progress.

Acknowledgements

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References

1) All compounds gave satisfactory analyses. Derivatives quoted without m. p. were obtained in the form of an oil.
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