Tetrahedron Letters No.58, pp. 5077-5080, 1969. Pergamon Press. Printed in Great Britain.

NMR SIGNALS OF METHYL GROUPS IN STRUCTURAL DETERMINATION OF TRITERPENES DRYOBALANONOLIC AND MANGIFERONIC ACIDS

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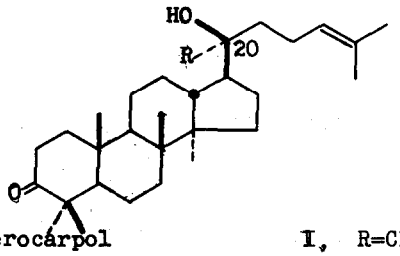
(Received in Japan 28 October 1969; received in UK for publication 18 November 1969)

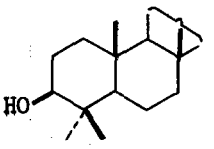
Recently considerable systematic data have been accumulated on the positions of NMR signals due to methyl groups of triterpenes, and complete assignment of these signals has become possible (1,2). Since, as is so for steroids (3,4), structural modifications on the carbon skeleton cause systematic changes in the methyl shifts, these data are of value in the elucidation of triterpene structures. Hitherto few examples of such application have been recorded (1,5,7), and in this communication we report two cases.

Dryobalanonolic acid. — Dryobalanops aromatica resin contains a number of triterpenes (6-8) one of which we name dryobalanonolic acid. Methyl dryobalanonolate, m.p. 148-149°, $[\alpha]_D$ +76°, analysed for $C_{31}H_{50}O_4$. Infrared absorption (in Nujol) at 3470, and 1165 cm^{-1} indicated presence of hydrogen-bonded hydroxy group(s). Carbonyl absorption at 1740 and 1705 cm^{-1} confirmed the existence of a methyl ester, and suggested that the fourth oxygen atom was in the form of a ketone. A trisubstituted olefinic function was indicated by bands at 1605 and 840 cm^{-1}.

60 MHz NMR spectrum of methyl dryobalanonolate confirmed these conclusions. Thus a 3-H singlet at δ 3.7, a 1-H broad singlet at δ 3.2, and a 1-H multiplet at δ 5.0-5.1 were assigned to methoxyl, hydroxyl and vinyl hydrogens respectively. Absence of resonance due to $-\overset{|}{C}H-O-$ showed that the hydroxyl was tertiary, a conclusion confirmed by lack of reactivity to acetic anhydride in cold pyridine. A 2-H group of signals near δ 2.4 was remarkably similar in shape to those due to the α-methylene in the dammarane 3-ketones dipterocarpol (hydroxy-

dammarenone-II) (I) and dryobalanone (II) which occur in the same resin (7).





Dipterocarpol	I,	$R=CH_3$	
Dryobalanone	II,	$R=CH_2OH$	IV, $R=CH_2OH$
Methyl dryobalanonolate	III,	$R=COOCH_3$	V, $R=COOCH_3$

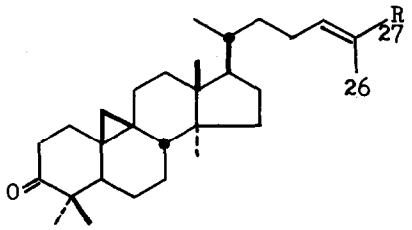
The methyl region of the NMR spectrum proved particularly instructive. There were two peaks at δ 1.55 and 1.65 due to methyl groups on double bond(s). In addition, in the region δ 0.9 to 1.1 five sharp peaks due to angular methyl groups were observed, the positions of which correspond nearly exactly to those in dryobalanone, and to five of the six in dipterocarpol (Table 1). The least-shielded angular methyl (on C-20) in dipterocarpol is known to be replaced in dryobalanone by a hydroxymethyl group (see I,II) (7); it is likely that in methyl dryobalanonolate, this methyl is replaced by a carbomethoxy group (as in III).

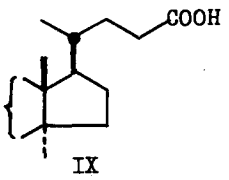
Confirmation was obtained through the following correlation. Reduction of methyl dryobalanonolate with sodium borohydride gave (in 79% yield) the corresponding 3β-alcohol, methyl 20(S)-3β,20-dihydroxydammar-24-en-21-olate (V),

TABLE 1

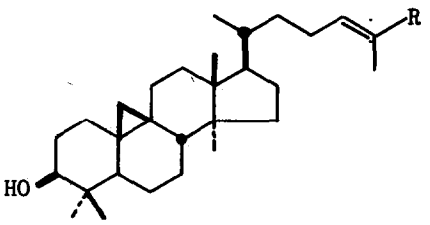
	Resonance frequencies (Hz)*						
	4α-Me	4β-Me	10β-Me	8β-Me	14α-Me	20-Me	C-26,27
Dipterocarpol(I)	65.5	63	57.5	60.5	54	69.5	97, 102
Dryobalanone(II)	65	62.5	57	60	53	-	98, 102
Methyl dryobalanonolate	64	62	56	59	51	-	94, 100

m.p. 121-123° , ν_m (Nujol) 3510, 3450, 1730 cm^{-1}. This product on treatment with lithium aluminium hydride yielded (77%) dryobalanol (IV) identical with an authentic sample obtained (7) by borohydride reduction of dryobalanone. Dryobalanonolic acid is thus 20(S)-20-hydroxydammar-24-en-3-on-21-olic acid.





IX



Cycloartenone VI, R=CH_3

Mangiferonic acid VII, R=COOH X, R=COOH

Methyl mangiferonate VIII, R=$COOCH_3$ XI, R=$COOCH_3$

Mangiferonic acid. — The resin of Shorea acuminata contains several triterpenes of which mangiferonic acid (VII) was of interest as it contains a cyclopropane ring. Mangiferonic acid has recently been described by Corsano and Mincione in conjunction with their structural elucidation of mangiferolic acid (X) (9). We demonstrate here the use of methyl shifts (Table 2) in reaching a conclusion on the relationship between methyl mangiferonate and cycloartenone (VI) (10).

Cycloartenone showed resonances due to two methyl groups on double-bond(s) (δ 1.65, 1.60), and four distinct signals due to angular methyl groups.† In the spectrum of methyl mangiferonate were similarly four angular methyl peaks† at nearly identical positions, but only one signal (δ 1.8) due to vinylic methyl. In low-field regions, methyl mangiferonate showed additional resonance at δ 3.7

TABLE 2

	Resonance frequencies (Hz)* †				
	4α-Me	4β-Me	13β/14α-Me	C-26	C-27
Cycloartenyl acetate	51	54	54,58	96	101
Cycloartenone (VI)	64.5	62	54.5,60	96	100
Methyl mangiferonate (VIII)	65	62	54,59	109	-
Mangiferonic acid (VII)	65	62	54,60	109	-
"Trisnor-acid" (IX)	65	62	54,59	-	-
Methyl mangiferolate (XI)	58.5	49	54,58.5	109	-
Mangiferolic acid (X)**	58	49	54,58	110	-

* Measured in $CDCl_3$ at 60MHz; relative to TMS.
† Signals due to the secondary methyl on C-20 are buried under other peaks.
** Mangiferolic acid from Shorea is identical to an authentic sample.

due to a carbomethoxy group. Above data thus support a structure for methyl mangiferonate in which one of the two vinylic methyl groups in the structure of cycloartenone is replaced by a carbomethoxy group. In confirmation, periodate-permanganate oxidation (12) of either cycloartenone (VI) or methyl mangiferonate (VIII) afforded the same trisnor-acid (IX), m.p. 191-193°.

In Table 2 are listed resonance frequencies of methyl groups of cycloartenone derivatives, assignments of individual signals being as discussed in reference 1. Chemical shift and long-range coupling considerations (11) lead to assignment to C-27 of the vinylic methyl signal in cycloartenone which is less shielded and broader. In allocating the vinylic methyl signal of mangiferolic acid to C-26, Corsano and Mincione's conclusion (9) on the trans configuration of the terminal double-bond is accepted.

We thank C.F. Low, Othman A. Manan and John Carrick for supply and identification of plant materials; Professors D.H.R. Barton and G. Ohta for samples of cycloartenone derivatives; and Dr. E. Mincione for a sample of mangiferolic acid.

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