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UVARIASTROL, A NOVEL CYCLOARTANE TRITERPENE FROM THE STEM BARK OF *UVARIASTRUM ZENKERI**

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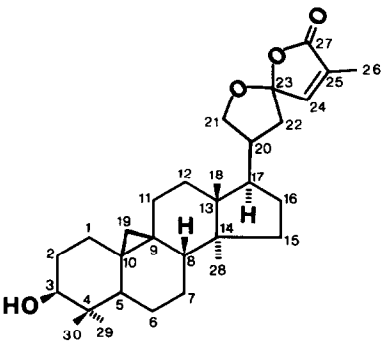
Key Word Index—*Uvariastrum zenkeri*; Annonaceae; cycloartane derivative; uvariastrol.

Abstract—Uvariastrol, a cycloartane triterpene with a novel tetrahydrofuran/furanone side-chain, has been isolated from the stem bark of *Uvariastrum zenkeri* and characterized using spectral characteristics, notably high-field ^{1}H NMR and ^{13}C NMR spectroscopy.

Uvariastrum zenkeri, a rain-forest tree found in south-east Nigeria and Cameroun [1], has not previously been the subject of phytochemical analysis [2]. As part of our continuing investigation of the chemistry of the Annonaceae [3], we now report on the examination of a sample of the stem bark of this species collected in the Korup National Park, Cameroun. This sample proved to be devoid of alkaloids but yielded two triterpenes, polycarpol (0.133%) [2] and a novel cycloartane derivative (**1**) (0.04%) to which we have assigned the trivial name uvariastrol.

Uvariastrol analysed for $C_{30}H_{44}O_4$, was optically active, and showed IR bands for a hydroxyl group (3400 cm^{-1}) and a carbonyl group (1750 cm^{-1}). Acetylation gave a monoacetate (1760, 1735 cm^{-1}) with no IR band above 3000 cm^{-1}. The ^{1}H NMR spectrum revealed an AB quartet centred at δ0.56 and 0.30 and four methyl singlets at δ0.98, 0.94, 0.86 and 0.74, typical of a cycloartane triterpene [4]. This was confirmed by the ^{13}C NMR spectrum which showed signals in close agreement with those published for the ring carbons and attached methyls of cycloartenol [5] (Table 1). A double-doublet at δ3.25 (J_1 = 7 3 Hz, J_2 = 3.9 Hz) was indicative of an axial oxymethine proton, thereby suggesting the usual 3-equatorial (β) hydroxy substituent. This was supported by the major ion *m/z* 328 (**2**) in the electron-impact mass spectrum which is due to the loss of ring A and the associated oxygen function and is typical of cycloartanes [4, 6].

In view of the close correlation between the ^{13}C NMR spectrum and that of cycloartenol, the three remaining oxygen functions must be placed in the C-17 side-chain. This was confirmed by the electron-impact mass spectrum which showed major ions at *m/z* 153 $[C_8H_9O_3]^+$, representing the entire C-17 substituent, and at *m/z* 109 $[153 - CO_2]^+$. Analysis of the ^{13}C spectrum revealed the eight carbons of the side-chain residue as three singlets (171.1, 133.2, 111.9 ppm), two doublets (144.6, 40.7 ppm), two triplets (73.9, 42.4 ppm) and one quartet (10.4 ppm). Similarly, the nine protons were all visible in the ^{1}H NMR spectrum. These were made up of an olefinic methyl at δ1.90 coupled to an olefinic proton at δ6.66, two AB quartets centred at δ4.26 and 3.58 and at δ2.15 and 1.79 for the non-equivalent protons of two methylene groups, and a multiplet centred at δ2.50 and coupled to both of the AB quartets; thus requiring the sequence $-CH_2-CH(R)-CH_2-$.



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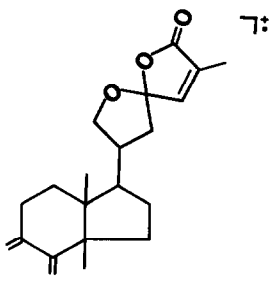

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*Part 11 in the series "Chemical Studies in the Annonaceae". For Part 10 see ref. [3].

Table 1. ^{13}C NMR chemical shift values (ppm) for (1) and cycloartenol [5]

Carbon No.	1*	Cycloartenol
C-1	31.8	31.9
C-2	30.2	30.3
C-3	78.6	78.5
C-4	40 4	40.3
C-5	46.9	47.0
C-6	20 8	21.0
C-7	27.6	28.0
C-8	47.7	47.8
C-9	19.8	20.0
C-10	26.3	26.0
C-11	26.1	26.0
C-12	35.6	35.5
C-13	45.5	45.1
C-14	48.2	48.7
C-15	31.2	32.8
C-16	25.8	26 5
C-17	51.0	52.2
C-18	18.8†	17.9†
C-19	29.8	29.8
C-20	40.7	
C-21	73 9	
C-22	42.4	
C-23	111.9	
C-24	144.6	
C-25	133.2	
C-26	10 4	
C-27	171 1	
C-28	19 1†	19.3†
C-29	25 3	25.4
C-30	13.8	14.0

*Run in $CDCl_3$ at 90.56 MHz.

†Values in the same vertical column are interchangeable.

The ^{13}C NMR signals at 171.1, 133.2, 144.6 and 10.4 ppm agree closely with the values reported for α,β-unsaturated-α-methyl five membered lactone systems, such as dehydroindicolactone [7], while both the NMR and IR spectral data are in accord with those published for similar lactone rings in triterpenes [8, 9]. The remaining four carbons and oxygen must be attributed to another furan ring system in which the oxidized C-21 (originally a methyl group) links through the oxygen bridge to C-23. This is supported by the singlet at 111.9 ppm which agrees closely with published shifts for C-16 of actein and derivatives, where C-16 is similarly linked with two oxygens [10]. Likewise, the assignment of the 73.9 ppm signal to C-21 is supported by published data for the saikosaponins [10]. This linkage also gives a sequence of protons that complies with that required and permits uvariastrol to be assigned structure **1**. The stereochemistry assigned to **1** is that typical of cycloartanes, in which ring C is in the boat conformation, and is based only on the marked similarity of spectral data to those published for cycloartanol and derivatives.

Uvariastrol (**1**) is the first cycloartane triterpene to be reported from the Annonaceae. However, given the relative ease with which cycloartanes undergo rearrangement to give unsaturated 10-methyl-9(11)-ene derivatives, it must be considered likely that the 7,9(11)-diene polycarpol, reported from several Annonaceae and present in *U. zenkeri*, derives biogenetically from a cycloartane precursor. The bicyclic tetrahydrofuran/furanone side-chain of **1** appears to be novel. The most closely related side-chain modifications are those of the cimicifugosides [11] and abietospiran [12] which possess the furanone system but in which the furan ring forms through C-23 and C-16 or C-17 rather than through C-23 and C-21.

EXPERIMENTAL

Plant material. Stem-bark of *U. zenkeri* Engl. & Diels was collected in the Korup National Park, Cameroun, during the summer of 1979. A voucher specimen, D. W. Thomas 604, has been deposited at the Herbarium of the Royal Botanic Gardens, Kew.

Extraction. The sun-dried bark (150 g) was milled and extracted in a Soxhlet apparatus for 3 days with petrol (bp 40–60°). Preliminary CC of the conc. extract over silica gel gave a mixture of triterpenes which were then separated by use of the Chromatotron (1 mm silica gel disc, solvent: toluene–EtOAc –HOAc, 80:6:7) to give polycarpol (200 mg) followed by uvariastrol (60 mg).

Uvariastrol (**1**). Recrystallized from EtOAc as needles and from MeOH as plates, mp 270°. $[\alpha]_D^{25} - 17.5°$ (*c* 0.2; $CHCl_3$). Found: $[M]^+$ 468.3255; $C_{30}H_{44}O_4$ requires: 468.3239. UV λ_{max}^{MeOH} nm (log ε): 241 (4.29). IR ν_{max}^{KCl} cm^{-1}: 3400, 2940, 1750, 1000. ^{1}H NMR (360 MHz, $CDCl_3$) δ: 6.66 (1H, *q*, *J* = 4.4 Hz, H-24), 4.26 (1H, *dd*, J_1 = 9 Hz, J_2 = 8 Hz, H-21), 3.58 (1H, *dd*, J_1 = 9 Hz, J_2 = 6 Hz, H-21), 3 25 (1H, *dd*, J_1 = 7.3 Hz, J_2 = 3.9 Hz, H-3$_{ax}$), 2.50 (1H, *m*, H-20), 2.15 (1H, *dd*, J_1 = 12.6 Hz, J_2 = 6.2 Hz, H-22$_{eq}$) 1.90 (3H, *d*, *J* = 4.4 Hz, 26-Me), 1.79 (1H, *dd*, J_1 = 12.6 Hz, J_2 = 11.6 Hz, H-22$_{ax}$), 0.98, 0.94 (2 × 3H, 2 × *s*, 18-Me and 29-Me), 0.86 (3H, *s*, 28-Me), 0.78 (3H, *s*, 30-Me), 0.56, 0.30 (2H, AB*q*, *J* = 4.2 Hz, 19-CH_2). For ^{13}C NMR, see Table 1. EIMS (70 eV) *m/z* (rel. int.): 468 $[M]^+$ (6), 453 $[M - Me]^+$ (13), 450 $[M - H_2O]^+$ (44), 435 $[M - Me - H_2O]^+$ (50), 328 $[C_{21}H_{28}O_3]^+$ (28), 153 $[C_8H_9O_3]^+$ (61), 109 $[C_7H_9O]^+$ (100).

Uvariastrol acetate **1** (20 mg) was dissolved in pyridine (5 ml) and Ac_2O (1 ml) and left overnight. Normal work-up gave uvariastrol acetate (13 mg) as needles, mp 266–268°. IR ν_{max}^{KCl} cm^{-1}: 1760, 1735. ^{1}H NMR (90 MHz, $CDCl_3$) δ: 2.02 (3H, *s*, COMe).

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MINOR TRITERPENES FROM *ORTHOPTERYGIUM HUANCUY*

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Key Word Index—*Orthopterygium huancuy*; Julianaceae; triterpenes; 3-oxo-20-hydroxy-lupan-28-oic acid; 3β,6β-dihydroxy-olean-18-en-28-oic acid.

Abstract—Two new triterpenes, 3-oxo-20-hydroxy-lupan-28-oic and 3β,6β-dihydroxy-olean-18-en-28-oic acids, along with oleanonic, morolic and sumaresinolic acids have been isolated from *Orthopterygium huancuy*. The structure of the first new terpene was determined by single crystal X-ray analysis.

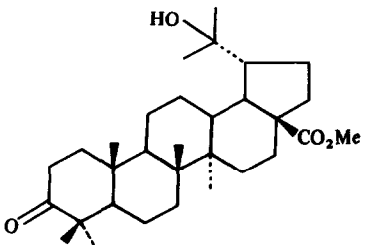
INTRODUCTION

In a previous paper [1], we reported the isolation of 3-oxo-6β-hydroxy-olean-18-en-28-oic, betulonic, moronic and 3-oxo-6β-hydroxy-olean-12-en-28-oic acids from *Orthopterygium huancuy* (Gray) Hemsl (Julianaceae). We report here on the isolation from the same plant of the new triterpenes, 3-oxo-20-hydroxy-lupan-28-oic and 3β,6β-dihydroxy-olean-18-en-28-oic acids, and the known ones oleanonic [2], morolic [3] and sumaresinolic acids [4].

RESULTS AND DISCUSSION

All of the compounds isolated in this study were minor components and were isolated in methyl ester form, by previous treatment of some fractions of the main chromatography with diazomethane. The known compounds were characterized by their physical and spectroscopic constants.

The more polar of the new compounds had a mass spectrum in accordance with a triterpenic acid methyl ester with two hydroxyl groups. In its ^{1}H NMR spectrum the geminal protons to this last function appeared at δ3.46 and 4.83, as a triplet and a broad singlet respectively. In addition, the chemical shift and the resonance form, δ5.15 (*s*), of the vinylic hydrogen were typical of an olean-18-ene skeleton with an esterified acid at C-28 [5]. This data suggested that the compound was the methyl ester of 3β, 6β-dihydroxy-olean-18-en-oic acid (**2**). Support for this was provided by the finding that the new compound was



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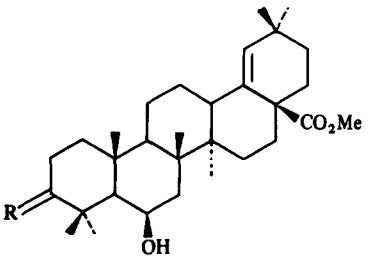

2 R = α-H, β-OH
3 R = O