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TWO TRITERPENES FROM THE LEAVES OF *NERIUM OLEANDER*

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Key Word Index—*Nerium oleander*, Apocynaceae, leaves, triterpenes, 3β-*p*-hydroxyphenoxy-11α-methoxy-12α-hydroxy-20-ursen-28-oic acid, 28-hydroxy-20-(29)-lupen-3,7-dione

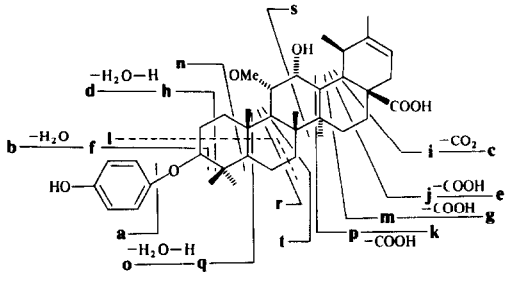
Abstract—Two new triterpenes, oleanderolic acid and kanerodione, have been isolated from the fresh, undried and uncrushed leaves of *Nerium oleander* and their structures established as 3β-*p*-hydroxyphenoxy-11α-methoxy-12α-hydroxy-20-ursen-28-oic acid and 28-hydroxy-20 (29)-lupen-3,7-dione, respectively, by means of chemical and spectral studies.

INTRODUCTION

In continuation of our studies [1–4] on the constituents of fresh, undried and uncrushed leaves of *Nerium oleander*, two new triterpenes oleanderolic acid, a weakly acidic triterpene, and kanerodione have been isolated from the neutral fraction of the methanolic extract of the leaves collected from the Karachi region in the month of July 1986. Their structures have been elucidated as **1** and **4**, respectively, from their high resolution mass, IR, UV and NMR spectral data. These triterpenes are of potential pharmacological significance since the fraction containing these constituents showed central nervous system depressant activity in mice.

RESULTS AND DISCUSSION

The UV spectrum of oleanderolic acid (**1**) showed maxima at 205, 230, 280, 310 and 330 nm, while the IR spectrum indicated bands at 3420–2500 (–COOH), 3400 (–OH), 2900–2845 (C–H stretching), 1700 (carbonyl of the acid group), 1600–1400 (four peaks, C=C and aromatic ring) and 1150–1000 cm^{-1} (C–O). Mass spectrometry (EI/FD/FAB) of **1** did not give a $[M]^+$ but demonstrated significant fragments at *m/z* 454.3409 ($C_{30}H_{46}O_3$), and 94 0418 (C_6H_6O, fragment a), the latter showing the presence of a phenoxy group in the molecule. The ^1H NMR spectrum showed seven three-proton signals at δ0.81, 0.85 (*d*, *J* = 7 2 Hz, H-29), 0.88, 0.90, 0 93, 0 94 and 1.66 indicating the triterpenoid nature of the compound [5]. The last singlet assigned to H-30 along with a one-proton multiplet at δ5.21 led to the location of a double bond at C-20 which was confirmed through CrO_3/pyridine oxidation of fully protected derivative **4**, furnishing the 22-ketone derivative (**5**) Three one-proton doublets of doublets at δ4.27 ($J_{3\alpha,2\beta}$ = 8.0 and $J_{3\alpha,2\alpha}$ = 7.0 Hz), δ4.12 ($J_{11\beta,9}$ = 11 8 and $J_{11\beta,12\beta}$ = 5 9 Hz) and δ4.18 ($J_{12\beta,13\beta}$ = 7 0 and $J_{12\beta,11\beta}$ = 5 9 Hz), demonstrated the presence of three oxygen substituents in the carbocyclic skeleton. The nature of these substituents was indicated as a methoxy group (δ3 63), a *p*-hydroxyphenoxy function (δ6.81, 2H, *d*, *J* = 7.0 Hz, δ7 12, 2H, *d*, *J* = 7.0 Hz, H-2′, 6′ and H-3′, 5′) and a hydroxyl function by spectral data. These data led to the calculation of the molecular formula as $C_{37}H_{54}O_6$ and it may be suggested that the ion at *m/z* 454.3409 ($C_{30}H_{46}O_3$) results from the loss of the *p*-hydroxyphenoxy and methoxy functions. Compound **1** formed a dimethyl derivative (**2**; δOMe = 3.61, 3.63, 3.65) on reaction with diazomethane which furnished the monoacetyl derivative (**3**; δ_{OAc} = 1.98) on reaction with acetic anhydride/pyridine. These observations indicated that **1** has a –COOH group apart from the functionalities discussed above Significant fragments (see structure **1**; Table 1) showed the location of the *p*-hydroxyphenoxy group at C-3, a –COOH group at C-17 and OMe and OH groups at C-11 and C-12, respectively. Decoupling experiments showed that the protons at δ4.12 and 4.18 are mutually coupled since irradiation of each of these converted the double doublet of the other to



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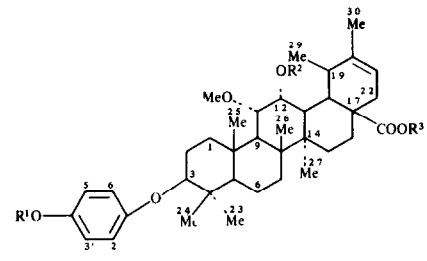
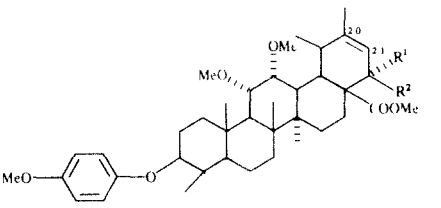


2 R¹ = R³ = Me R² = H
3 R¹ = R³ = Me, R² = Ac

Table 1 High resolution mass spectral data of compound **1**

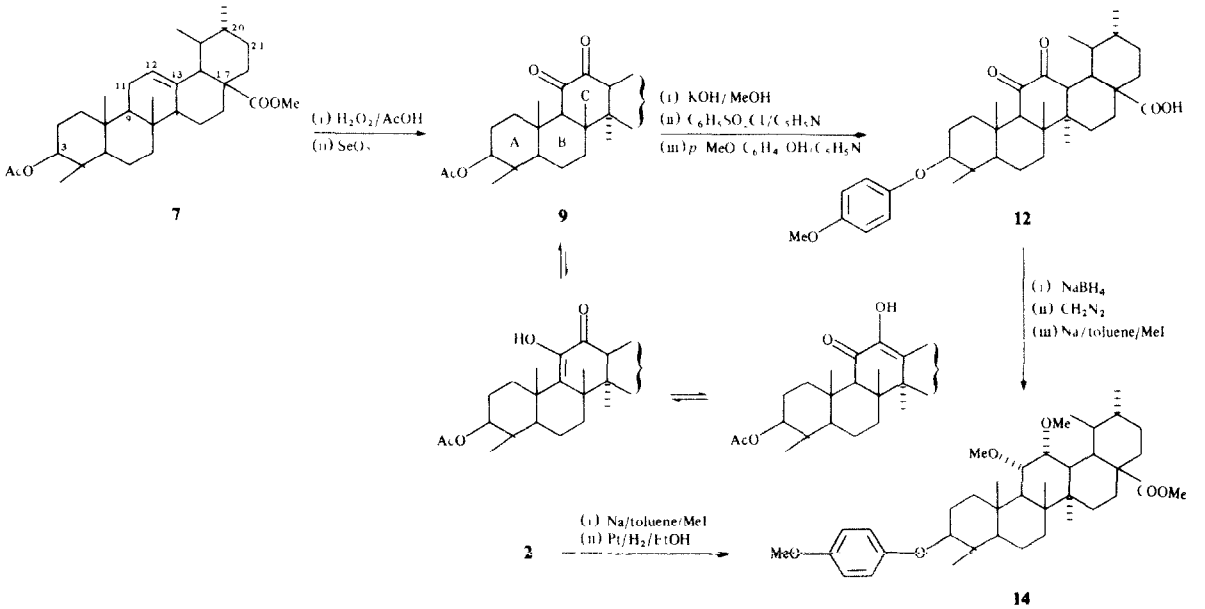
Fragment	High resolution mass	Corresponding formula	Fragment	High resolution mass	Corresponding formula
a	94 0418	C_6H_6O (+H)	**l**	174 1135	$C_{12}H_{14}O$
b	105 0435	C_7H_5O	**m**	179 1156	$C_{11}H_{15}O_2$ (−H)
c	107 0825	C_8H_{11}	**n**	194 1212	$C_{12}H_{18}O_2$ (+2H)
d	119 0568	C_8H_7O	**o**	214 1337	$C_{15}H_{18}O$
e	120 0882	C_9H_{12}	**p**	219 1318	$C_{14}H_{19}O_2$
f	122 0281	$C_7H_6O_2$	**q**	233 1541	$C_{15}H_{21}O_2$ (+H)
g	134 1049	$C_{10}H_{14}$	**r**	248 1777	$C_{16}H_{24}O_2$ (+2H)
h	138 0725	$C_8H_{10}O_2$ (+2H)	**s**	248 1376	$C_{15}H_{20}O_3$ (−2H)
i	151 0744	$C_9H_{11}O_2$ (−H)	**t**	261 1941	$C_{17}H_{25}O_2$ (+H)
j	165 0995	$C_{10}H_{13}O_2$ (−H)	$[M-C_6H_5O_2]^+$	454 3409	$C_{30}H_{46}O_3$
k	174 1311	$C_{13}H_{18}$	OMe		

a doublet These signals have been assigned to H-11 and H-12, respectively, as in the ^{1}H NMR spectrum of the acetylmethyl derivative (**3**) the chemical shift of H-11 remained unaffected while that of H-12 shifted to δ5 32 The coupling constants of these protons led to the α-orientation of both the methoxy and the hydroxy functions In each homonuclear decoupling experiment the proton at δ4 27 remained unaffected and could be assigned to H-3 Its coupling constants further showed that the *p*-hydroxy-phenoxy substituent is β-oriented Furthermore, irradiation at δ6 81 collapsed the doublet at δ7.12 to a singlet and *vice versa*, thus establishing the *para* substitution of the hydroxy function in the aromatic ring In the light of these observations, structure **1** has been assigned to oleanderolic acid The structure and stereochemistry of the various centres of oleanderolic acid have been conclusively established through catalytic reduction of the trimethyl derivative (**4**) of **1** to **6** which was identical with the product (**14**) obtained from acetylmethyl ursolic acid following the path depicted in Scheme 1 and described in the Experimental

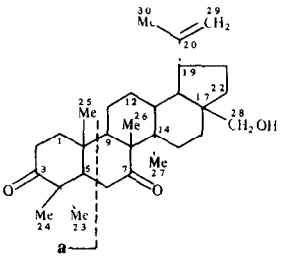


4 $R^1 = R^2 = H$
5 $R^1 R^2 = O$
6 $R^1 = R^2 = H$ 20 21 dihydro

Exact mass measurement of the $[M]^+$ of **15** led to its formulation as $C_{30}H_{46}O_3$ ($[M]^+$ *m/z* 454 3446 through EI source, 455 3520 through +ve ion FAB source) The ^{1}H NMR spectrum showed six methyl singlets at δ0 76, 0 82, 0 93, 0 97, 1 02 (H-23, H-24, H-25, H-26, H-27) and 1 68 (H-30) and two one-proton doublets at δ4 58 (J_{gem} = 1 5 Hz, H-29a) and 4 68 (J_{gem} = 1 5 Hz, H-29b) indicating the lupane type skeleton [5] Two one-proton



Scheme 1



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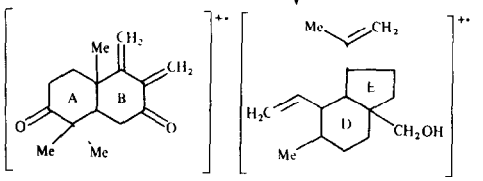
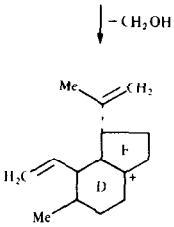
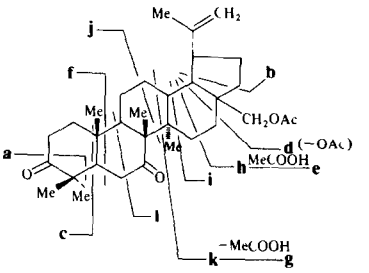


Fragment c (+H) Fragment d



Fragment b

doublets at δ3.32 (J_{gem} = 11.0 Hz, H-28a) and δ3 79 (J_{gem} = 11 0 Hz, H-28b) in the ^{1}H NMR spectrum exhibited the presence of a $-CH_2OH$ group and the fragments at *m/z* 234.1982 (fragment **d**) and 203.1797 (fragment **b**) corresponding to formulae $C_{16}H_{26}O$ and $C_{15}H_{23}$, respectively, (see Experimental), showed that it is located at C-14 or C-17 [6]. On acetylation with acetic anhydride/pyridine **15** afforded the monoacetyl derivative (**16**, δOAc = 2.04), in the ^{1}H NMR spectrum of which the carbinylic signals shifted to δ4 0 (J_{gem} = 11.0 Hz) and δ4.29 (J_{gem} = 11.0 Hz) The fragments **b** and **d** in the high resolution mass spectrum (Table 2) of **16** conclusively established the position of the hydroxyl group at C-28. The calculation of the double bond equivalence and IR spectrum (1710 cm^{-1}) indicated that the remaining oxygen atoms are carbonyl functions. The fragments at *m/z* 138 1043



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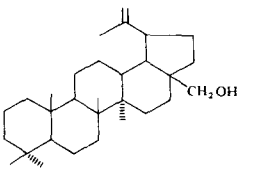

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(fragment **a**), 233.1554 (fragment **c**) and 234.1982 (fragment **d**) in the mass spectrum of **15** corresponding to formulae $C_9H_{14}O$, $C_{15}H_{21}O_2$ and $C_{16}H_{26}O$ (*vide* structure), respectively, indicated that one oxygen atom is located in ring A while the other is in ring B Their positions at C-3 and C-7 were finally established by the fragments **a**, **c**, **f** and **l** (Table 2) observed in the high resolution mass of **16** (see structure **16**). In the light of these data structure **15** has been assigned to kanerodione which was finally confirmed by its Wolff–Kishner reduction to a product, the melting point and spectral data of which are comparable with those reported for 3-desoxy betulin [7–9]

EXPERIMENTAL

Mps uncorr MS were recorded on double focussing instruments connected to a computer system. Exact masses of various fragments were obtained through peak matching and high resolution MS ^{1}H NMR spectra were recorded in $CDCl_3$ at 300 MHz Optical rotations were measured at 24° in $CHCl_3$ Merck silica gel 60 PF_{254} was used for TLC Leaves of *N. oleander* were identified by Dr S I Ali (Department of Botany, University of Karachi) A voucher specimen (N. OL-1) has been deposited in the Herbarium of the Botany Department, University of Karachi

Table 2 High resolution mass spectral data of compound **16**

Fragment	High resolution mass	Corresponding formula	Fragment	High resolution mass	Corresponding formula
a	70 0418	C_4H_6O	**h**	194.1364	$C_{12}H_{18}O_2$
b	84 0967	C_6H_{12} (+2H)	**i**	208.1475	$C_{13}H_{20}O_2$
c	97 0631	C_6H_9O (−H)	**j**	234.1610	$C_{15}H_{22}O_2$
d	121 0996	C_9H_{13} ($C_{11}H_{16}O_2$ − OAc)	**k**	248 1729	$C_{16}H_{24}O_2$
e	134 1103	$C_{10}H_{14}$	**l**	344 2320	$C_{22}H_{32}O_3$
f	139 1125	$C_9H_{15}O$ (+H)	$[M]^+$	496 3550	$C_{32}H_{48}O_4$
g	190 1681	$C_{14}H_{22}$ (+2H)			

The residue left on removal of solvent from the combined MeOH percolates of the fr undried and uncrushed leaves of *N oleander* (30 kg) was divided into acidic and neutral frs The neutral, petrol insol fr was dissolved in MeOH and kept in the cold overnight when a colourless crystallizate settled out which was filtered, and ultimately identified as a mixt of ursolic and oleanolic acids by comparison of the MS, IR, ^{1}H and ^{13}C NMR data [10, 11] of their acetyl Me derivatives (Ac_2O–pyridine, CH_2N_2) with those reported in the lit The mother liquor was subjected to prep TLC (silica gel $CHCl_3$–MeOH, 19 1) and the major band was rechromatographed by TLC (silica gel, petrol–EtOAc, 9 1), which afforded **1** as a colourless crystallizate In another working the neutral fr was dissolved in 90% MeOH and successively shaken out with petrol and petrol–C_6H_6 (1 1) The residue obtained from the MeOH phase after usual work-up, was dissolved in C_6H_6 and the soln treated with a little petrol A small insol darkish ppt was filtered off and the filtrate freed of the solvent under red pres The light yellow powdery residue was then subjected to prep TLC (silica gel, C_6H_6–EtOAc, 4 1) when **15** was obtained as a homogeneous constituent

Oleanderolic acid (**1**) Irr plates (petrol–EtOAc, 4 1), mp 262–264° (33 mg, 1 03% yield, of the wt of total neutral fr), $[\alpha]_D^{24}$ +50 0° ($CHCl_3$, *c* 0 04) HRMS *m/z* 454 3409 [M−$C_6H_5O_2$ −OMe]$^+$, $C_{30}H_{46}O_3$ requires 454 3446, EIMS *m/z* (rel int %) 454 [M−$C_6H_5O_2$−OMe]$^+$ (2), 436 (4), 423 (3), 390 (2), 356 (5), 314 (3), 248 (38), 203 (52), 189 (45), 135 (50), 119 (64) and 69 (100), UV λ_{max}^{MeOH} nm 205, 230, 280, 310 and 330 nm, IR $\nu_{max}^{CHCl_3}$ cm^{-1} 3420–2500 (–COOH), 3400 (–OH), 2900–2845 (C–H stretching), 1700 (carbonyl of the acid group), 1600–1400 (four peaks, C=C and aromatic ring) and 1150–1000 cm^{-1} (C–O), ^{1}H NMR δ 0 81, 0 88, 0 90, 0 93, 0 94 and 1 66 (each 3H, s, 6 × Me), 0 85 (3H, *d*, *J* = 7 2 Hz, H-29), 2 28 (1H, *d*, $J_{9,11\beta}$ = 11 8 Hz, H-9), 3 63 (3H, s, OMe), 4 12 (1H, *dd*, $J_{11\beta,9}$ = 11 8 and $J_{11\beta,12\beta}$ = 5 9 Hz, H-11β), 4 18 (1H, *dd*, $J_{12\beta,13\beta}$ = 7 0 and $J_{12\beta,11\beta}$ = 5 9 Hz, H-12β), 4 27 (1H, *dd*, $J_{3\alpha,2\beta}$ = 8 0 and $J_{3\alpha,2\alpha}$ = 7 0 Hz, H-3α), 5 21 (1H, *t*, *J* = 3 4 Hz, H-21), 6 81 (2H, *d*, *J* = 7 0 Hz, H-2′ and H-6′) and 7 12 (2H, *d*, *J* = 7 0 Hz, H-3′ and H-5′), HRMS (Table 1)

Methylation of **1**. Methylation of **1** (25 mg) with CH_2N_2 at room temp afforded **2** (26 mg), irr plates (MeOH), mp 254–256° EIMS *m/z* (rel int %) 468 [M−$C_7H_7O_2$−OMe]$^+$ (2), 411 (2), 262 (8), 203 (18), 189 (14), 148 (12), 89 (40), 69 (70) and 57 (100), IR $\nu_{max}^{CHCl_3}$ cm^{-1} 3400 (–OH), 2900–2840 (C–H stretching), 1725 (carbonyl of ester group) and 1600–1350 (four peaks of aromatic ring, >C=C), ^{1}H NMR δ 0 82, 0 89, 0 91, 0 93, 0 95 and 1 67 (each 3H, s, 6 × Me), 0 86 (3H, *d*, *J* = 7 0 Hz, H-29), 2 29 (1H, *d*, $J_{9,11\beta}$ = 11 8 Hz, H-9), 3 61, 3 63, 3 65 (each 3H, s, 3 × OMe), 4 12 (1H, *dd*, $J_{11\beta,9}$ = 11 8 and $J_{11\beta,12\beta}$ = 5 9 Hz, H-11β), 4 17 (1H, *dd*, $J_{12\beta,13\beta}$ = 7 0 and $J_{12\beta,11\beta}$ = 5.9 Hz, H-12β), 4 28 (1H, *dd*, $J_{3\alpha,2\beta}$ = 8 0 and $J_{3\alpha,2\alpha}$ = 7 0 Hz, H-3α), 5 21 (1H, *t*, *J* = 3 4 Hz, H-21), 6.81 (2H, *d*, *J* = 7 0 Hz, H-2′ and H-6′) and 7 12 (2H, *d*, *J* = 7 0 Hz, H-3′ and H-5′)

Acetylation of **2** Acetylation of **2** (6 mg) with Ac_2O/pyridine at room temp afforded the monoacetate **3** (6 2 mg), irr plates (EtOAc), mp 258–260° EIMS *m/z* (rel int %) 510 [M−$C_7H_7O_2$ −OMe]$^+$ (1), 423 (2), 313 (6), 239 (8), 203 (4), 89 (18) and 57 (100), IR $\nu_{max}^{CHCl_3}$ cm^{-1} 2900–2850 (C–H stretching), 1730 (*br*, carbonyls) and 1620–1360 (four peaks of aromatic ring, >C=C), ^{1}H NMR δ 0 82, 0 89, 0 91, 0 93, 0 95 and 1 67 (each 3H, s, 6 × Me), 0 86 (3H, *d*, *J* = 7 2 Hz, H-29), 2 29 (1H, *d*, $J_{9,11\beta}$ = 11 8 Hz, H-9), 1 98 (3H, s, OAc), 3 61, 3 63, 3 65 (each 3H, s, 3 × OMe), 4 13 (1H, *dd*, $J_{11\beta,9}$ = 11 8 and $J_{11\beta,12\beta}$ = 5 9 Hz, H-11β), 4 28 (1H, *dd*, $J_{3\alpha,2\beta}$ = 8 0 and $J_{3\alpha,2\alpha}$ = 7 0 Hz, H-3α), 5 21 (1H, *t*, *J* = 3 4 Hz, H-21), 5 32 (1H, *dd*, $J_{12\beta,13\beta}$ = 7 0 and $J_{12\beta,11\beta}$ = 5 9 Hz, H-12β), 6 81 (2H, *d*, *J* = 7 0 Hz, H-2′ and H-6′) and 7 11 (2H, *d*, *J* = 7 0 Hz H-3′ and H-5′)

Williamson reaction of **2** **2** (15 mg) was refluxed with Na in toluene for *ca* 6 hr MeI was added to the reaction mixt which was refluxed for further 2 hr and worked-up in the usual manner Purification of the residue by prep TLC afforded the triMe derivative **4** (12 mg), needles (MeOH), mp 260 262 , EIMS *m z* (rel int %) 482 [M − 123 − 31]$^+$ (5)

Oxidation of **4** *to* **5** A soln of **4** (6 mg) in pyridine was added to a slurry of CrO_3 (10 mg) and pyridine (1 ml) amd stirred for 4 hr at room temp Work-up of the reaction mixt in the usual manner furnished the ketone (**5**) rods (MeOH), mp 246 248 , EIMS *m/z* (rel int %) 496 [M − 123 − 31]$^+$ (3)

Hydrogenation of **4** *to* **6** **4** (6 mg) was hydrogenated in EtOH over Pt black at room temp for 36 hr Conventional work-up gave the dihydrotriMe derivative (**6**), needles (MeOH), mp 251–253 EIMS *m z* (rel int %) 484 [M − 123 − 31]$^+$ (6), 324 (10), 265 (12), 195 (20), 124 (40) 109 (65) and 77 (70) ^{1}H NMR δ 2 30 (1H, *d*, $J_{9,11\beta}$ = 12 0 Hz, H-9) 3 68, 3 67 3 65, 3 64 (each 3H, s, 4 × OMe), 4 15 (1H, *dd* $J_{11\beta,9}$ = 12 0 and $J_{11\beta,12\beta}$ = 5 5 Hz, H-11β), 4 17 (1H, *dd*, $J_{12\beta,13\beta}$ = 7 0 and $J_{12\beta,11\beta}$ = 5 5 Hz, H-12), 4 28 (1H, *dd*, $J_{3\alpha,2\beta}$ = 8 0 and $J_{3\alpha,2\alpha}$ = 7 0 Hz, H-3α)

3β-Acetoxy-12-oxo-methyl-ursa-28-oate (**8**) Acetyl Me ursolic acid (**7**) (200 mg) obtained by acetylation (Ac_2O–pyridine) and methylation (CH_2N_2) of ursolic acid in the usual manner was oxidized with H_2O_2–HOAc according to the procedure described earlier [12] The colourless residue thereby obtained was purified by flash CC (silica gel, $CHCl_3$) ultimately yielding the 12-keto derivative (**8**) (100 mg), needles (MeOH), mp 251–252° (lit mp 246–250), EIMS *m/z* (rel int %) 528 [M]$^+$ (10) 513 (20), 498 (19), 453 (21) 439 (8), 317 (11), 278 (21) 262 (48) 218 (22), 203 (79), 189 (83), 75 (72) and 133 (88)

3β-Acetoxy-11,12-dioxo-methyl-ursa-28-oate (**9**) SeO_2 (25 mg) was added to dioxan (2 5 ml) dil with a few drops of H_2O and stirred at *ca* 50° [13] After a few min the SeO_2 went into soln , **8** (100 mg) was added and the reaction mixt refluxed with stirring for 10 hr when TLC showed one major UV detectable spot This was worked-up in the usual manner ultimately yielding **9** (70 mg), small rods (MeOH), mp 214 216 EIMS *m/z* (rel int %) 542 [M]$^+$ (3) 527 (11) 513 (21), 453 (21), 317 (28), 292 (5), 278 (32), 218 (42) 189 (40), 175 (73) and 133 (45), UV λ_{max}^{MeOH} 292 nm

3β-p-Methoxyphenoxy-11,12-dioxo-ursa-28-oic acid (**12**) Hydrolysis (2% KOH in MeOH, overnight, room temp) of **9** (60 mg) gave 11,12-dioxo-3β-hydroxy-ursa-28-oic acid (**10**) which was dissolved in pyridine (1 ml), treated with $PhSO_2Cl$ (1 ml) at room temp overnight and worked-up in the usual manner affording 3-*O*-benzenesulphonyl derivative (**11**) as an amorphous powder, EIMS *m z* (rel int %) 455 [M − 141 − 30]$^+$ (4), 278 (20) 233 (18), 189 (54), 157 (18), 141 (20), 125 (5), 93 (30) and 77 (100) Reaction of **11** with *p*-MeO C_6H_4 OH in pyridine (overnight room temp) and purification by prep TLC (silica gel, $CHCl_3$ MeOH, 19 1) after usual work-up the reaction mixt furnished the 3-*O*-*p*-methoxyphenyl derivative (**12**) (42 mg) as the major product Fine needles from MeOH mp 271 273 , EIMS *m/z* (rel int %) 467 [M − 125]$^+$ (5), 278 (24), 233 (10), 189 (60) 163 (41), 124 (20), 109 (11), and 77 (54)

11α,12α-Dimethoxy-3β-p-methoxyphenoxy-methyl-ursa-28-oate (**14**) **12** (40 mg) was dissolved in MeOH and an aq soln of $NaBH_4$ (50 mg) added with stirring at room temp The product obtained on usual work-up of the reaction mixt after *ca* 2 hr stirring showed one major band which was characterized as the 11β,12β-dihydroxy derivative, ^{1}H NMR δ 2 01 (1H *d*, $J_{9,11\alpha}$ = 5 7 Hz, H-9), 4 16 (1H *dd* $J_{12\alpha,13\beta}$ = 11 5, $J_{12\alpha,11\alpha}$ = 5 7 Hz, H-12α), 4 19 (1H, *t*, $J_{11\alpha,9}$ = $J_{11\alpha,12\alpha}$ = 5 7 Hz, H-11α) Whereas the ^{1}H NMR of one of the minor components (7 mg) showed that it was 11α,12α-dihydroxy isomer (**13**), EIMS *m z* (rel int %) 548 [M − 31 − 17]$^+$ (3) 531 (7), 454 (6) 436 (12), 393 (20), 238 (5) 315

(11), 171 (60), 124 (20) and 109 (25); ^{1}H NMR δ2.12 (1H, *d*, $J_{9,11\beta}$ = 11 8 Hz, H-9), 4 14 (1H, *dd*, $J_{11\beta,9}$ = 11 8 and $J_{11\beta,12\beta}$ = 5.6 Hz, H-11β), 4 16 (1H, *dd*, $J_{12\beta,13\beta}$ = 7 0 and $J_{12\beta,11\beta}$ = 5 6 Hz, H-12β), **13** on methylation (CH_2N_2, Na–toluene–Me I) gave 20,21-dihydro-triMe oleanderolic acid (**14**) which was identical with **6** obtained by methylation and catalytic reduction of **2**

Kanerodione **15.** Elongated rods (C_6H_6–EtOAc, 4 1), mp 178–180° (30 mg, 0 08% yield of the wt of total neutral fr), $[\alpha]_D^{24}$ −36 36° ($CHCl_3$, *c* 0 11) HRMS *m/z* 454 3443 $[M]^+$, $C_{30}H_{46}O_3$ requires 454 3446, 138 1043 ($C_9H_{14}O$, fragment **a**), 203.1797 ($C_{15}H_{23}$, fragment **b**), 233 1554 ($C_{15}H_{21}O_2$, fragment **c**) and 234 1982 ($C_{16}H_{26}O$, fragment **d**), FABMS *m/z* 455 3520 $[MH]^+$ $C_{30}H_{47}O_3$, requires 455 3522, EIMS *m/z* (rel int %) 454 $[M]^+$ (7), 426 (4), 411 (22), 394 (4), 340 (2), 300 (5), 234 (28), 203 (100), 189 (50), 133 (48), 95 (64) and 54 (72), UV λ_{max}^{MeOH} 219 nm· IR $\nu_{max}^{CHCl_3}$ cm^{-1} 3440 (–OH), 2900–2840 (C–H stretching), 1710 (carbonyl groups), 1640 (>C=C), 1150–1000 (C–O) and 880 (>C=CH_2), ^{1}H NMR δ0 76, 0 82, 0 93, 0 97, 1 02, 1 68 (each 3H, *s*, 6 × Me), 3 32 (1H, *d*, J_{gem} = 11 0 Hz, H-28a), 3 79 (1H, *d*, J_{gem} = 11 0 Hz, H-28b), 4 58 (1H, *d*, J_{gem} = 1 5 Hz, H-29a) and 4 68 (1H, *d*, J_{gem} = 1 5 Hz, H-29b)

Acetylation of **15** Acetylation of **15** with Ac_2O–pyridine at room temp afforded the monoacetate **16**, elongated rods (EtOAc), mp 167–169° EIMS *m/z* (rel int %) 496 (2), 436 (2), 203 (6), 189 (10), 149 (42), 125 (25), 111 (42), 95 (44), 83 (44) and 57 (100), IR $\nu_{max}^{CHCl_3}$ cm^{-1} 2920–2850 (C–H stretching), 1720 (carbonyl of acetoxy group), 1640 (>C=C), 1100–1000 (C–O) and 880 (>C=CH_2), ^{1}H NMR δ0 76, 0 82, 0 94, 0 98, 1 02 and 1 68 (each 3H, *s*, 6 × Me), 2 04 (3H, *s*, OAc), 4 00 (1H, *d*, J_{gem} = 11 0 Hz, H-28a), 4 29 (1H, *d*, J_{gem} = 11 0 Hz, H-28b), 4 58 (1H, *d*, J_{gem} = 1 5 Hz, H-29a) and 4.69 (1H, *d*, J_{gem} = 1 5 Hz, H-29b). HRMS (Table 2)

Wolff–Kishner reduction of **15** **15** (10 mg) was reduced with 25 mg of Na (dissolved in 2 ml of EtOH and 1 ml of dry H_2N–NH_2) for 15 hr at 180–200° Usual work-up of the reaction mixt afforded **17**, mp 141–142° (MeOH) EIMS *m/z* (rel int. %): 426 $[M]^+$ (10) ^{1}H NMR δ0 73, 0 76, 0 79, 0 92, 0.97, 1.69 (each 3H, *s*, 6 × Me), 3 30 (1H, *d*, *J* = 10.5 Hz, H-28a), 3.76 (1H, *d*, *J* = 10 5 Hz, H-28b), 4 60 (1H, *d*, J_{gem} = 1 5 Hz, H-29a), 4 71 (1H, *d*, J_{gem} = 1 5 Hz, H-29b)

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