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A REVISION OF THE STRUCTURE OF CUCURBITACIN S FROM *BRYONIA DIOICA*

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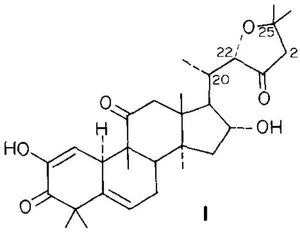
Key Word Index—*Bryonia dioica*; Cucurbitaceae; cucurbitacins; cucurbitacin S; ^{1}H NMR.

Abstract—^{1}H NMR studies at 400 MHz on cucurbitacin S and its derivatives suggest that the structure of cucurbitacin S previously isolated from *Bryonia dioica* should be revised from (22S)-22,25-anhydro-2,16α,22,25-tetrahydroxy-3,11,23-trioxo-cucurbita-1,5-diene to (24S)-16,24-anhydro-2,16α,24,25-tetrahydroxy-3,11,22-trioxo-cucurbita-1,5-diene.

INTRODUCTION

We recently isolated a new series of cucurbitacin derivatives from *Bryonia dioica* [1] which appeared to be very similar to cucurbitacin S [2] except that the former were α-ketols in ring A whereas cucurbitacin S was a diosphenol. We had previously isolated cucurbitacin S from the same source. The structural elucidation of this material was accomplished by analysis of the ^{1}H NMR spectrum of a methoxyl-containing acetal derivative which led us to propose structure **1** for cucurbitacin S.



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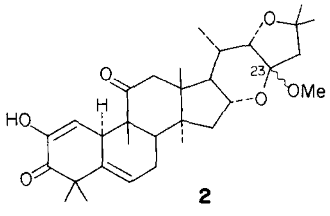

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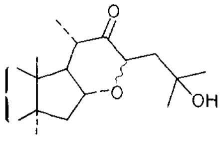

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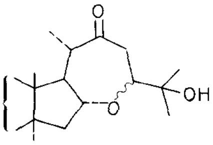

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For the new series of compounds, analogous ^{1}H NMR analysis was carried out in the expectation that a side chain identical with that of cucurbitacin S would be found but the results were surprising and showed that this series was derived from a 22-carbonyl compound, whereas it was previously thought that that carbonyl was at C-23. In view of this the structure of cucurbitacin S itself has been re-investigated and forms the subject of this communication.

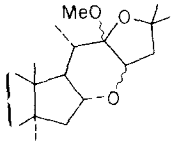
RESULTS AND DISCUSSION

Chromatography of the chloroform-soluble portion of an acid-hydrolysed extract of *B. dioica* Jacq. root allowed isolation of, in addition to known substances [2, 3], a series of compounds which had the characteristics of diosphenols and gross spectral data indicating their similarity with the previously isolated cucurbitacin S and its methoxy-acetal, for which structures **1** and **2** respectively had been proposed [2]. Extreme difficulty in purification was again experienced but two materials were able to be isolated. One was identical in every respect with cucurbitacin S [2] whereas another had an identical mass spectrum but showed only two carbonyl absorptions in the IR. It was evidently an isomer of cucurbitacin S. A further quantity of a material identical with the methoxyl-containing acetal of cucurbitacin S [2] was also obtained. In the 400 MHz ^{1}H NMR spectrum of this material, previously thought to be **2**, an INDOR experiment, irradiating the C-21 methyl doublet (δ0.99) located the position of the C-20 methine at *ca* δ2.00. Decoupling at this frequency collapsed, as before [2], both the C-21 methyl doublet and a low field doublet ($J = 3$ Hz) at δ3.69 which was hence assigned to the C-22 methine. This was the crucial piece of evidence which led to the previous structural proposal.

In the present work, because a further quantity of cucurbitacin S itself was now available, analogous experiments were carried out on this latter material.

This experiment could not be undertaken previously because of lack of material. The results were unexpected. Irradiation at the methyl doublet (δ1.02) located H-20 at δ1.95, as before. Conversely, irradiation at δ1.95 collapsed this methyl doublet (as expected) but induced no change in the low field doublet which, in the spectrum of this compound, appeared at δ4.00, analogous to the signal at δ3.69 in the spectrum of the methoxyl-containing acetal. This observation is inconsistent with the previously proposed structures [2]. Assuming an arrangement of carbon atoms as in the known cucurbitacins, the more detailed ^{1}H NMR experiments lead to a structure for cucurbitacin S with a carbonyl group at position 22 (not C-23) with one hydroxyl group and one ether substituent at 23, 24 or 25. C-22 must bear the carbonyl group, since if the carbonyl were at either 23 or 24, coupling would be observed between the C-20 methine hydrogen and at least one further hydrogen at 22, which is now shown not to be the case from the 400 MHz ^{1}H NMR decoupling and INDOR experiments. Since only C-20 is secondary, C-25 must bear an oxygen function in addition to the two methyl groups. Bearing in mind the previous observations, the only possible structures for the side chain compatible with these observations are thus **3** and **4** which differ only in the point of attachment to the side chain of the ether bridge from C-16. Treatment of cucurbitacin S with acidic methanol produces a methoxyl-containing acetal which is further cyclized to give another ether ring [2], the only possible partial structures of which are thus **5** or **6**.

An INDOR experiment on the spectrum of the methoxy-acetal of cucurbitacin S, irradiating at δ3.70, undoubtedly did cause changes at *ca* δ2.00, as found previously [2]. This means that on removal of the carbonyl group by acetalization, the chemical shift of at least one of the hydrogen atoms in the methylene group of the side chain (at 23 or 24) is moved upfield by *ca* 0.12 ppm (from δ1.88) or downfield by 0.22 ppm (from δ2.22). Only if the methylene group is adjacent to the side chain carbonyl can this be achieved, which strongly indicates structures **4** and **6**, the full formulae of which are shown as **7** and **8**.



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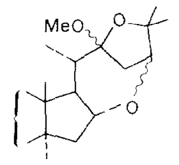

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More detailed ^{1}H NMR decoupling studies allowed observation of the resonance positions of each of the side chain hydrogens and these are listed in Table 1. These data explain the previous observation that the δ3.69 signal in the spectrum of **6** was apparently coupled with the signal due to H-20 (which led to the proposal for an incorrect structure) because of the co-incidental identity of the shifts for H-20 and H-23, both of which apparently resonate at about the same position in the spectrum of **7**. It can be seen that the ^{1}H NMR values for H-20 are similar in the spectra of both compounds but the C-23 hydrogens give values which are almost identical to that of H-20 in the case of the methoxyl-containing acetal but are well separated in the spectrum of cucurbitacin S.

With regard now to the material isolated here for the first time which is isomeric with cucurbitacin S, an examination of the IR spectrum showed that it lacked a carbonyl absorption but it had a band at 3500 cm^{-1}, indicative of the presence of a hydroxyl group. A likely structure is thus the corresponding hemi-acetal compound **9**. A quantity of this material sufficient for detailed 400 MHz ^{1}H NMR studies could not be isolated but a decoupling experiment at 90 MHz showed that irradiation at δ2.25 collapsed the δ4.00 doublet (H-24) but did not cause a change in appearance of the methyl doublet. Evidently, in this compound, the H-23 signals are similar in shift to those of **7**. **9** could also be prepared by synthesis from **8** by reaction with aqueous acid. It is interesting to comment on the values obtained for the hydroxyketone **7** and the hemi-acetal **9** which appear to be more or less identical, but different from those of the methoxyl-containing compound. Presumably, **7** and **9** are rapidly interconverted and it may be that the spectra of both compounds in fact represent equilibrium mixtures between the open and closed forms. This is confirmed by the appearance of a signal at δ212 (i.e. a carbonyl) in the ^{13}C NMR spectrum of the hemi-acetal **9**, which may only be assigned to C-22 in the keto-form. The presence of the methoxyl group in **8** presumably confers enough stability on the material to prevent a similar isomerization. The ^{13}C NMR data of these compounds are reported fully in Table 2 and are wholly consistent with the proposed structures.

As a result of these detailed ^{1}H NMR studies it is possible to make some stereochemical deductions. In the doubly cyclized side chain, two asymmetric centres are present so four isomers are theoretically possible. Examination of Dreiding models, however, indicates that if the 24 centre is *R*, i.e. H-24 is β, only the 22*R* compound may form. Similarly, if 24 is assumed to be *S*, only the 22*S* isomer is possible. This assumes the normal cucurbitacin stereochemistry at 16, 17 and 20. The signal for H-24 in the ^{1}H

Table 1. The chemical shifts for the side chain hydrogens of **7** and **8** (δ, $CDCl_3$)

Hydrogen No.	**7**	**8**
20	1.95	1.95
23	1.88, 2.22	1.94, 1.98
24	4.00	3.70

Table 2. ^{13}C NMR data for compounds **7**, **8** and **12** (δ, CDCl$_3$)

Carbon No.	7	8	12
1	114.9	114.9	131.6
2	144.6	144.6	143.2
3	198.6	198.6	194.8
4	46.9	46.0	46.8
5	137.0	137.0	136.2
6	120.6	120.6	121.2
7	23.8	23.8	23.8
8	34.6	34.6	35.7
9	43.2	46.5	48.9
10	42.3	42.3	42.2
11	212.9	213.0	212.8
12	47.9	48.0	48.0
13	48.9	48.5	49.0
14	49.3	49.0	49.3
15	41.8	46.1	41.8*
16	82.1	76.2	82.0
17	49.6	50.6	49.7
20	32.1	33.8	32.1
22	212.6, 105.5	108.6	212.7, 105.5
23	47.5	48.0	43.2*
24	85.6	81.3	85.7
25	71.1	71.6	73.5
26, 27, 29	27.9	29.9	29.9
	29.7	29.5	29.6
	29.9	27.8	27.2
The other Me (18, 19, 21, 28, 30)	11.0	15.3	11.0
	18.0	18.0	18.1
	20.2	20.3	20.1
	20.7	20.3	20.2
	23.8	23.8	20.4
OMe	—	50.6	—
C̲OMe	—	—	168.7
COC̲H$_3$	—	—	21.0

*These assignments may be reversed.

NMR spectrum of **8** occurs as a sharp doublet, with only one coupling constant ($J = 5$ Hz). From these data it may be stated that the more likely structure for **8** is as shown, i.e. the 22*S*,24*S*-isomer.

It must be stated that the material considered to be cucurbitacin S in the present work had spectral data almost identical with that previously reported [2] except that the IR spectrum lacked absorption at 1750 cm^{-1}. The spectrum on the other hand did have several carbonyl absorptions which gave rise to a broadly based band and it may have been that the previous material [2], which was isolated only in very small quantity, was somewhat impure.

The revised structure for cucurbitacin S is thus: (24*S*) - 16,24 - anhydro - 2,16α,24,25 - tetrahydroxy - 3,11,22 - trioxo - cucurbita - 1,5 - diene (**7**), its hemi-acetal isomer: (22*S*,24*S*) - 16,24 - anhydro - 22,25 - anhydro - 2,16α,22,22,24,25 - hexahydroxy - 3,11 - dioxo - cucurbita - 1,5 - diene (**9**) and the methoxyl-containing acetal: (22*S*,24*S*) - 16,24 - anhydro - 22,25 - anhydro - 2,16α,22,24,25 - pentahydroxy - 22 - methoxy - 3,11 - dioxo - cucurbita - 1,5 - diene (**8**).

It is now clear that not only are the acetals likely to be artefacts formed during the acid hydrolysis but cucurbitacin S itself may also not be a natural compound. A very likely hypothetical natural compound is **10**. This could serve as a parent for cucurbitacin S which could undergo cyclization and acetal formation at C-22 as shown in Fig. 1.

Some of the original hydrolysed extract was acetylated before chromatography. Separation of this allowed isolation of a further two related materials. Mass spectrometry of the less polar substance (obtained first by CC) showed a molecular ion peak at *m*/*z* 554 (whereas cucurbitacin S methoxy-acetal had [M]$^+$ 512). The ^{1}H NMR spectrum showed peaks almost identical with those of cucurbitacin S acetal but an additional singlet, integrating for 3H, was present at δ2.20 indicating that the material was an acetate. No hydroxyl group absorption appeared in

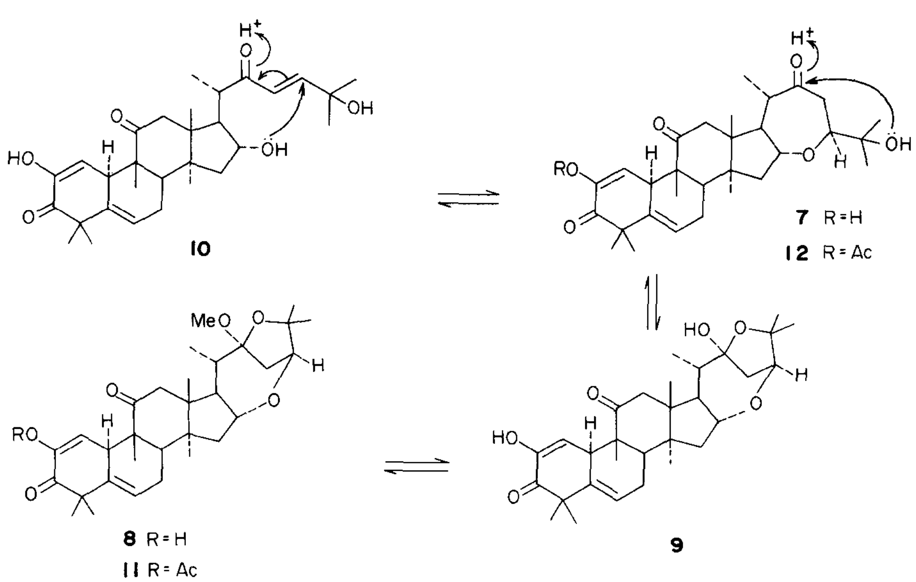

Fig. 1. Suggested preparation of cucurbitacin S and other artefacts from **10** showing stereochemistry.

the IR spectrum thus the most probable structure for this substance is the 2-acetate (**11**) of the methoxy-acetal of cucurbitacin S. The second material showed a molecular ion peak at *m/z* 540 (whereas cucurbitacin S had $[M]^+$ at *m/z* 498). Its ^{1}H NMR spectrum showed peaks almost identical with those of cucurbitacin S but an additional singlet, integrating for three hydrogens, at δ2.20 was present, indicating that this material too was an acetate. The substance was identical with that prepared by acetylation of cucurbitacin S and the most likely structure is the 2-acetate (**12**) of cucurbitacin S. From the ^{13}C NMR spectrum, however, it is probable that it also contains some of the corresponding hemi-acetal material. These substances were not isolated in the previous work [2].

The isolation of the previous series of compounds [1] and the likelihood that a precursor of cucurbitacin S is a Δ^{23}-hydroxy-22-ketone compound may be taken as evidence that C-20 hydroxylation occurs as a last step in the biosynthesis of the cucurbitacin side chain.

EXPERIMENTAL

The general details are as previously reported [2] except that ^{1}H NMR spectra were recorded at 400 MHz using a Bruker WH400 instrument. The plant material was collected at the Royal Botanic Gardens, Kew, London, in July 1976 and extracted as described previously [2]. A voucher specimen has been deposited in the Museum in the Department of Pharmacy, Chelsea College. The $CHCl_3$-soluble fraction obtained after hydrolysis in 2 N methanolic HCl of the methanolic extract of the defatted root powder was divided into two parts.

One (60 g) was adsorbed on the top of a column of Si gel G. In addition to known compounds [2–4], elution with EtOAc–toluene (3:47) and crystallization from EtOAc gave colourless plates (*ca* 100 mg) of (22*S*,24*S*) - 16,24 - anhydro - 22,25 - anhydro - 2,16,22,24,25 - pentahydroxy - 22 - methoxy - 3,11 - dioxo - cucurbita - 1,5 - diene (**8**), mp 263–265°, identical with material previously assigned structure **2**. Lit. mp 265–267° [2].

Elution with EtOAc–toluene (1:9) gave an amorphous solid, mp 128–130°, which could not be crystallized but had spectral characteristics similar to those of cucurbitacin S, (**7**) (lit. mp 75° [2]) except that this latter material was evidently purer. A further quantity of this material was obtained by synthesis from **8** (see below).

Elution with EtOAc–toluene (9:41) gave a material (18 mg) which also could not be crystallized but gave spectral data identical with those of the hemi-acetal isomer (**9**) of cucurbitacin S. This substance could also be obtained by synthesis from the methoxy-acetal (**8**) of cucurbitacin S (see below).

The second part of the extract (65 g) was acetylated with Ac_2O and pyridine in the usual way and, after the normal work-up, was adsorbed onto the top of a column of Si gel G. Elution with EtOAc–toluene (1:19) allowed isolation of a white solid which was crystallized from EtOAc to yield colourless prisms (72 mg) of (22*S*,24*S*) - 2 - acetoxy - 16,24 - anhydro - 22,25 - anhydro - 16α,22,24,25 - tetrahydroxy - 22 - methoxy - 3,11 - dioxo - cucurbita - 1,5 - diene (**11**), mp *ca* 240°; UV λ_{max}^{EtOH} (log ϵ) nm: 235 (4.50); IR ν_{max}^{Nujol} cm^{-1}: 1760 (enol acetate), 1690 (C-11 and diosphenyl carbonyls), 1665 (C=C); ^{1}H NMR (90 MHz, $CDCl_3$): δ0.80 (3H, *s*), 0.97 (3H, *d*, $J = 7.0$ Hz), 1.40 (3H, *s*), 1.29 (6H, *s*), 1.31 (6H, *s*), 1.35 (3H, *s*), 2.18 (3H, *s*), 3.23 (3H, *s*), 3.50 (1H, *br m*, H-10), 3.85 (1H, *d*, $J = 2.5$ Hz), 4.00 (1H, *sextuplet*, $J = 9.5$, 9.5, 4.5 Hz, H-16), 5.80 (1H, *br m*, H-6), 6.36 (1H, *d*, $J = 2.5$ Hz, H-1); MS *m/z* (rel. int.): 554 (16), 523 (8), 513 (9), 498 (18), 442 (4), 362 (4), 349 (14), 317 (5), 292 (6), 203 (10), 164 (100). Accurate mass measurement: found: 554.3241; $C_{33}H_{46}O_7$ requires 554.3241.

Elution with EtOAc–toluene (3:47) and crystallization from EtOAc gave colourless plates (245 mg) of (22*S*,24*S*) - 16,24 - anhydro - 22,25 - anhydro - 2,16α,22,24,25 - pentahydroxy - 22 - methoxy - 3,11 - dioxo - cucurbita-1, 5-diene (**8**): mp 263–265°; identical with material previously assigned structure **2**.

Elution with EtOAc–toluene (9:41) gave a material, prep. TLC (EtOAc–cyclohexane, 1:4, × 8) of which showed that this material was a mixture of at least four compounds. Repeated prep. TLC (EtOAc–cyclohexane, 1:9, × 12) was carried out on this material. Isolation by scraping the Si gel which corresponded with the major compound was only successful in enriching the sample. No matter how many developments, when the scrape produced was chromatographed analytically, always at least two spots were visible. Attempted crystallization from EtOAc gave a yellowish white foam (which corresponded in the R_f value with that of the lower component) of 2-acetyl cucurbitacin S (**12**) ((24*S*) - 2 - acetoxy - 16,24 - anhydro - 16α,24,25 - trihydroxy - 3,11,22 - trioxo - cucurbita - 1,5 - diene) (**12**); mp 138–140°; UV λ_{max}^{EtOH} (log ϵ) nm: 286 (5.20); IR ν_{max}^{Nujol} cm^{-1}: 3500 (OH stretching), 1755 (diosphenol acetate), 1717 (C-22 ketone), 1685 (C-11 ketone) and 1660 (C-3 ketone); ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.82 (3H, *s*), 1.04 (3H, *d*, $J = 7$ Hz, C-21), 1.30 (3H, *s*), 1.32 (3H, *s*), 1.34 (3H, *s*), 1.36 (3H, *s*), 1.38 (6H, *s*), 1.50 (1H, *dd*, $J = 4.5$, 11 Hz, H-15α or β), 1.86 (1H, *dd*, $J = 4.5$, 11 Hz, H-15β or α), 1.88 (1H, *d*, $J = 12$ Hz, H-23), 2.14 (1H, *dd*, $J = 9.5$, 12 Hz, H-17), 2.22 (3H, *s*, acetate), 2.26 (1H, *dd*, $J = 5$, 12 Hz, H-23), 2.44 (1H, *d*, $J = 12$ Hz, H-12α), 3.04 (1H, *d*, $J = 12$ Hz, H-12β), 3.52 (1H, *br m*, H-10), 3.81 (1H, *sextuplet*, $J = 9.5$, 9.5, 4.5 Hz, H-16), 4.00 (1H, *d*, $J = 5$ Hz, H-24), 5.82 (1H, *m*, H-6) and 6.37 (1H, *d*, $J = 2.5$ Hz, H-1); MS *m/z* (rel. int.): 540 (20), 522 (61), 498 (23), 482 (25), 465 (9), 453 (9), 436 (12), 421 (11), 179 (10) and 164 (100). ^{13}C NMR data is found in Table 2 from which it is clear that this material is still not entirely pure. It is likely that this product is in fact an equilibrium mixture of 2-acetyl cucurbitacin S and (22*S*,24*S*) - 2 - acetyl - 16,24 - anhydro - 22,25 - anhydro - 16,22,22,24,25 - pentahydroxy - 3,11 - dioxo - cucurbita-1,5-diene. It is likely that the interconversion occurred during the chromatographic separation.

Acetylation of cucurbitacin S. Cucurbitacin S (10 mg) was acetylated with Ac_2O in pyridine in the usual way. Normal work-up allowed isolation of a yellowish foam, spectroscopically identical with 2-acetyl cucurbitacin S isolated from the acetylated extract (q.v.).

Reaction of (22S,24S)-16,24 - *anhydro* - 22,25 - *anhydro* - 2,16α,22,24,25 - *pentahydroxy* - 22 - *methoxy* - 3,11 - *dioxo* - *cucurbita* - 1,5 - *diene* (**8**) *with aq. HCl.* The title compound (100 mg) was dissolved in Me_2CO (3 ml), 20% HCl (0.7 ml) was added and the mixture refluxed for 2 hr. The soln was concd and diluted with H_2O (*ca* 100 ml). Neutralization with Na_2CO_3 soln and extraction with $CHCl_3$ gave, after drying and evaporation of the solvent, a residue which showed three components by TLC. The major component was separated by prep. TLC (EtOAc–cyclohexane, 1:9) and crystallization from EtOAc–petrol (bp 40–60°) (1:1) afforded white needles (50 mg) of (22*S*,24*S*) - 16,24 - anhydro - 22,25 - anhydro - 2,16α,22,22,24,25 - hexahydroxy - 3,11 - dioxo - cucurbita - 1,5 - diene (**9**); mp 142–144°; UV λ_{max}^{EtOH} (log ϵ)

nm: 268 (4.60); (shifted in the presence of alkali to 315 nm); IR ν_{max}^{Nujol} cm^{-1}: 3500 (OH stretching), 1685 (C-11 and diosphenyl carbonyls), 1660 (C=C); ^{1}H NMR (90 MHz, $CDCl_3$): δ 0.83 (3H, *s*), 1.02 (3H, *d*, $J = 7.00$ Hz, C-21), 1.04 (3H, *s*), 1.24 (3H, *s*), 1.36 (6H, *s*), 1.38 (6H, *s*), 3.04 (1H, *d*, $J =$ 12 Hz, H-12β), 3.48 (1H, *br m*, H-10), 3.80 (1H, *sextuplet*, $J = 9.5$, 9.5, 4.5 Hz, H-16), 4.00 (1H, *d*, $J = 5$ Hz, H-24), 5.80 (1H, *m*, H-6), 5.91 (1H, *s*, $\underline{H}O$), 5.95 (1H, *d*, $J = 2.5$ Hz, H-1); MS *m/z* (rel. int.): 498 (14), 481 (22), 480 (60), 465 (6), 317 (14), 255 (14), 247 (6), 229 (10), 204 (15), 202 (7), 179 (9), 164 (100). ^{13}C NMR: Table 2.

Purification of the second component of this reaction by prep. TLC allowed isolation of a yellowish solid which crystallized from EtOAc–petrol (1:1) (15 mg) of (24*S*) - 16,24 - anhydro - 2,16α,24,25 - tetrahydroxy - 3,11,22 - trioxo - cucurbita - 1,5 - diene (cucurbitacin S) (7); mp 128–130°; UV λ_{max}^{EtOH} (log ϵ) nm: 273 (5.41); IR ν_{max}^{Nujol} cm^{-1}: 3500 (OH-stretching), 1715 (C-22 carbonyl), 1680 (C-11 and diosphenyl carbonyls), 1660 (C=C); ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.83 (3H, *s*), 1.02 (3H, *d*, $J = 7$ Hz, C-21), 1.05 (3H, *s*), 1.24 (3H, *s*), 1.36 (6H, *s*), 1.38 (6H, *s*), 1.50 (1H, *dd*, $J = 4.5$, 11 Hz, H-15α or β), 1.86 (1H, *dd*, $J = 4.5$, 11 Hz, H-15β or α), 1.88 (1H, *d*, $J = 12$ Hz, H-23), 2.14 (1H, *dd*, $J = 9.5$, 12 Hz, H-17), 2.26 (1H, *dd*, $J = 5$, 12 Hz, H-23), 2.44 (1H, *d*, $J = 12$ Hz, H-12α), 3.05 (1H, *d*, $J = 12$ Hz, H-12β), 3.47 (1H, *m*, H-10), 3.80 (1H, *sextuplet*, $J = 9.5$, 9.5, 4.5 Hz, H-16), 4.00 (1H, *d*, $J = 5$ Hz, H-24), 5.77 (1H, *br m*, H-6), 5.90 (1H, *s*, $\underline{H}O$), 5.96 (1H, *d*, $J = 2.5$ Hz, H-1); MS *m/z* (rel. int.): 498 (2), 481 (3), 480 (4), 430 (2), 418 (3), 415 (3), 404 (4), 386 (8), 359 (6), 277 (13), 263 (10), 252 (11), 249 (14), 221 (11), 197 (15), 164 (19); accurate mass measurement: calculated for $C_{30}H_{42}O_6$: 498.2981. Found: 498.2984. ^{13}C NMR: Table 2. Lit. mp 75° [2].

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REFERENCES

1. Hylands, P. J. and Mansour, E-S. S. (1982) *J. Chem. Soc. Perkin Trans.* 1 (submitted).
2. Hylands, P. J. and Salama, A. M. (1976) *Phytochemistry* **15**, 559.
3. Cattel, L., Caputo, O., Delprino, L. and Biglino, G. (1978) *Gazz. Chim. Ital.* **108**, 1.
4. Hylands, P. J., Mansour, E-S. S. and Oskoui, M. T. (1980) *J. Chem. Soc. Perkin Trans* 1, 2933.