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PASSIFLORINE, A NEW GLYCOSIDE FROM *PASSIFLORA EDULIS*

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Key Word Index—*Passiflora edulis*, Passifloraceae; triterpenoids, passiflorine

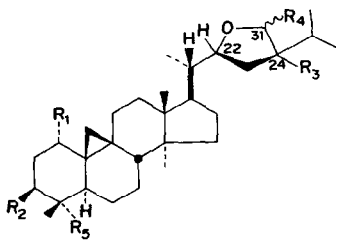
Abstract—Passiflorine, a new glycoside isolated from *P. edulis*, was shown by chemical and spectroscopic considerations to be (22*R*), (24*S*)-22,31-epoxy-24-methyl-1α,3β,24,31-tetrahydroxy-9,19-*cyclo*-9β-lanostan-28-oic acid β-D-glucosyl ester (**1**).

INTRODUCTION

Passionflower extracts have an ancient tradition in the folk medicine of Europe and America, and, owing to their sedative and anti-hypertensive properties, a number of *Passiflora* species are present as official drugs in the Pharmacopoeia of several countries. To date, only common flavonoids and simple indole alkaloids of the harmane type, which show no significant pharmacological activities, have been isolated from this genus [1,2].

As part of a long range investigation aimed at the eventual identification of the active principles, an examination of the extractives of *P. edulis* Sims, collected in India, was undertaken. Column chromatography of the MeOH extract of the air-dried leaves allowed the isolation of *ca* 1% of a new cyclopropane triterpene glycoside, which we have named passiflorine. On the basis of chemical and spectral evidence, passiflorine has now been shown to have the structure **1**.

It is of interest to note that a number of *Passiflora* species, including *P. mollissima* Bayley, *P. calcarata* Mast., *P. lechenaultii* DC., all of Indian origin, and *P. quadrangularis* L., collected near Kinshasa (Zaire), were found to contain this new compound, whose pharmacological properties are currently under investigation.



(**1**) $R_1 = R_2 = R_3 = R_4 = OH$; $R_5 = CO_2$-β-D-glucose
(**2**) $R_1 = R_2 = R_3 = R_4 = OH$; $R_5 = CO_2Me$
(**3**) $R_1 = R_2 = R_4 = OAc$; $R_3 = OH$; $R_5 = CO_2Me$
(**4**) $R_1 = R_2 = R_3 = OAc$; $R_4 = \beta$-OAc; $R_5 = CO_2Me$
(**5**) $R_1 = R_2 = R_3 = OAc$; $R_4 = \alpha$-OAc; $R_5 = CO_2Me$
(**8**) $R_1 = R_2 = OH$; $R_3R_4 = -OCMe_2O-$; $R_5 = CO_2Me$
(**9**) $R_1 = R_2 = OAc$; $R_3R_4 = -OCMe_2O-$; $R_5 = CO_2Me$
(**11**) $R_1 = R_2 = R_3 = OH$; $R_4 = OMe$; $R_5 = CO_2Me$
(**14**) $R_1 = OH$; $R_3R_4 = -OCMe_2O-$; $R_2R_5 = -OCMe_2CH_2O-$
(**15**) $R_1 = R_2 = OAc$; $R_3R_4 = -OCMe_2O-$; $R_5 = CH_2OAc$

RESULTS AND DISCUSSION

The crystalline glycoside, passiflorine, mp 183°, $[\alpha]_D$ + 47·1°, was initially hydrolyzed with gaseous HCl in boiling dioxane. Under these conditions, D-glucose (1 mol) and a complex mixture

of acidic compounds, very difficult to separate even after treatment with CH_2N_2 and extensive chromatography, were obtained

On the contrary, MeOH–KOH treatment of **1** removed the glucose moiety affording a methyl ester (**2**) in almost quantitative yields The passiflonic acid methyl ester (**2**) had the molecular formula $C_{32}H_{52}O_7$, as indicated by its molecular ion peak at *m/e* 548·3711 (calc. for $C_{32}H_{52}O_7$ 548·3711), and it did not contain olefinic double bonds, as shown by its ^{13}C-NMR spectrum.

As the IR spectrum of passiflorine exhibited a CO absorption at 1729 cm^{-1}, attributable to an ester function, and its NMR spectrum in C_5D_5N showed no signal due to carbomethoxy groups, the methyl ester **2** clearly arose from a transesterification reaction which allowed the detachment of the sugar residue In particular, the NMR spectrum of **1** showed a doublet at δ 6 40 (J 8 Hz) assignable to the axially oriented C-1 proton of the glucose moiety, which establishes as β the nature of the glycosidic linkage.

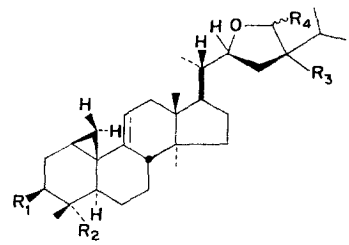
Compound **2** formed a triacetate (**3**) and two tetraacetates, **4** and **5**, which showed no OH stretching bands in the IR spectra, thus indicating that the remaining oxygen atom of **2** must be engaged in the formation of an ethereal grouping.

Among its characteristic signals, the NMR spectrum (C_6D_6) of the triacetate (**3**) revealed the presence of five aliphatic methyl groups between δ 1·3 and 0·85, a carbomethoxy function at δ 3·45, a pair of one-proton doublets at δ 0·50 and 0·12 (J 14 Hz), characteristic of geminal cyclopropane protons, and two protons as *dd* at δ 5·96 (J_1 12, J_2 5 Hz) and 4 75 (J_1, J_2 3 Hz), respectively. Double resonance experiments showed that both these signals were coupled with a one-proton *ddd* signal at δ 2·40 (J_1 14, J_2 5, J_3 3 Hz) and with another proton resonating at $\delta \simeq 1$ 80 These data suggest that the signals at δ 5·96 and 4·75 were due to an equatorial and an axial acetoxymethyne proton, respectively, which were located in a 1,3-*trans* relationship on a six-membered ring.

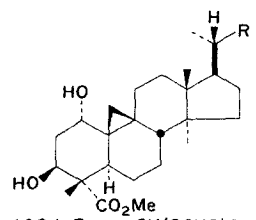
The carbon atoms bearing the two protons were adjacent to two quaternary centres and were separated by a methylene grouping. The equatorial proton of the latter resonated at δ 2·40, whereas the axial one occurred at δ 1·80, in the same zone where other protons resonate.

In addition, in its NMR spectrum **3** showed a strongly deshielded one-proton singlet at δ 6 40 and a one-proton *ddd* at δ 4 68 (J_1, J_2 7, J_3 4 Hz). In the spectra of the two tetraacetates, **4** and **5**, these two signals were at δ 6·94 and 6·74 and at δ 4·44 and 4·08, respectively, but no additional protons on carbon carrying oxygen were descernible Therefore **2** must contain a tertiary hydroxyl function and, due to the absence of olefinic double bonds, the signals at δ 6 40 and 4 68 in the spectrum of **3** must be assigned to a strongly deshielded acetoxymethyne proton and to a proton located on the carbon carrying the ethereal oxygen, respectively Information about the location of the cyclopropane ring was not available from the above spectral data, but most cyclopropane triterpenes and the *Buxus* alkaloids are based on a cycloartane skeleton thereby providing some suggestion for a possible placement of this ring

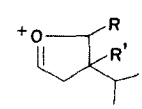
It is known [3] that treatment of cycloartenyl acetate with gaseous hydrogen chloride in $CHCl_3$ results in the opening of the cyclopropane ring with the formation of a mixture of olefins in which the 9(11)-ene isomer predominates. The same reaction, carried out on **2** using dioxane as solvent, provided a less polar methyl ester (**6**), $C_{32}H_{50}O_6$, which was one of the products obtainable directly from passiflorine by acidic hydrolysis followed by treatment with CH_2N_2 and column



(**6**) $R_1 = R_3 = R_4 = OH$; $R_2 = CO_2Me$
(**7**) $R_1 = R_3 = R_4 = OAc$; $R_2 = CO_2Me$
(**12**) $R_1 = R_3 = OH$; $R_4 = OMe$; $R_2 = CO_2Me$
(**16**) $R_1 = R_3 = R_4 = OH$; $R_2 = CO_2Me$; 9-11 dihydro
(**17**) $R_3 = OH$; $R_2 = CO_2Me$; $R_1 = R_4 = O$; 9-11 dihydro



(**10**) $R = -CH(OCHO)CH_2COCHMe_2$
(**13**) $R = -CH=CH-COCHMe_2$



(a) $R = R' = OH$
(b) $RR' = -OCMe_2O-$
(c) $R = OMe$; $R' = OH$

chromatography. Compound **6** formed a triacetyl derivative (**7**), which displayed no OH absorption in its IR spectrum. The NMR spectrum of **7** showed the signals due to the carbomethoxy group at δ 3·45, the axial acetoxymethyne proton at δ 5·55 (*dd*, J_1 12, J_2 6 Hz), the oxymethyne proton at δ 4·07 and the deshielded acetoxymethyne proton at δ 6·76. In comparison with the spectrum of the triacetate (**3**) the signal of the equatorial acetoxymethyne proton was absent, whereas the presence of a trisubstituted double bond was indicated by the appearance of a one-proton signal as a *bd* at δ 4·93 (J = 4 Hz). A cyclopropane ring was still present, however only a signal for one proton at δ 0·05 as a *dd* (J_1 = 8, J_2 = 4 Hz) was discernible.

All these data can be rationalized if **2** is assigned the suggested cycloartane skeleton and the 1,3-*trans* diol system is placed on the A-ring of this skeleton. In particular, if the equatorial oxymethyne proton of **2** is at C-1 the axial oxymethyne proton is at C-3. It is therefore quite reasonable that in acidic media this system gives rise to a rearrangement arising from the protonation and elimination of the axial C-1 hydroxyl group followed by the migration of the C-19, C-10 bond and the elimination of the C-11 axial proton.

The upfield signal at δ 0·05 in the spectrum of **7** was thus due to the C-19 α proton, which couples with the C-19 β and C-1 protons and suffers for steric reasons the shielding effect of the C-9, C-11 double bond. On the other hand the C-11 proton signal (δ 4·93) was also shifted upfield by comparison to the same signal (δ 5·19) of lanosta-9(11)-ene-3β-yl acetate, due to the shielding effect of the cyclopropane ring.

Treatment of **2** with acetone and anhydrous copper sulphate furnished an acetonide (**8**), which upon acetylation provided a diacetyl derivative (**9**). In its NMR spectrum **9** showed signals which account for an unaltered 1,3-*trans* diol system, whereas the acetoxymethyne proton resonating at δ 6·40 in the spectrum of the triacetate **3** shifted at δ 5·53. Furthermore, $NaIO_4$ oxidation of **2** yielded a ketone (**10**), $C_{32}H_{50}O_7$, carbonyl IR absorptions at 1729, 1720 and 1696 cm^{-1} and NMR signals ($CDCl_3$) at δ 8·22 (1H, *s*), which clearly contained a formate residue. The tertiary and the remaining secondary hydroxy groups of **2** were therefore engaged in the formation of a vicinal diol system, the secondary alcoholic function being located on the same carbon bearing the ethereal oxygen atom. The presence of a hemiacetal grouping received convincing support in the NMR spectrum (C_5D_5N) of **2** which contained two singlets at δ 5·44 and 5·72, each integrating for 0·5 H, assignable to the two epimeric hemiacetal protons and in the formation of *two* tetraacetates (**4** and **5**) from **2**. Furthermore, treatment of **2** with cold 1% HCl–MeOH followed by neutralization provided a mixture of two unseparable methyl ethers (**11**), which showed in the NMR spectrum *s* signals at δ 4·99 (0·67 H) and 4·72 (0·33 H) for the ketal protons and at δ 3·48 (1 H) and 3·44 (2 H) for the methoxy groups. An additional methyl ether (**12**), which arose from the above described rearrangement involving the 1, 9, 10 and 11 carbon atoms, was obtained if the acidic alcoholic solution of **2** was evaporated to dryness. Crystallization of the residue from MeOH provided only one isomer, which showed (C_5D_5N) the ketal proton at δ 4·93 (1H, *s*), the methyl ether function at δ 3·41 (3H, *s*), a cyclopropane proton at δ 0·05 (*dd*, J_1 8, J_2 4 Hz) and the vinyl proton at δ 6·1 (*bd*, J 5 Hz). The α-hydroxy hemiacetal grouping of **2** is part of a 2,3-dihydroxy tetrahydrofurane ring as, upon treatment with diluted KOH, **10** easily eliminated formic acid affording an unsaturated ketone (**13**). In its NMR spectrum, **13** exhibited signals for two *trans*-oriented olefinic protons at δ 6·14 (*d*, J 16 Hz) and 6·86 (*dd*, J_1 16, J_2 8 Hz) and an isopropyl group adjacent to a CO function at δ 2·82 (1H, *hept*, J 7 Hz) and 1·16 (6H, *d*, J 7 Hz). In addition, the spectrum showed the absence of the *ddd* appearing at δ 4·68 in the spectrum of **3**, which must therefore be assigned to a proton located on the carbon carrying the ethereal oxygen of the tetrahydrofurane ring.

All the foregoing data lend convincing support for the placement of an additional carbon atom at the 24 position of the cycloartane skeleton, that is passiflioric acid methyl ester is a 24-methylcycloartane derivative. The presence of a 2,3-dihydroxy tetrahydrofurane ring involving the 22, 24 and 31 carbon atoms was also corroborated by the intense peaks at *m/e* 145 (ion *a*, 71%), 185 (*b*, 100%), 159 (*c*, 100%) in the MS spectra of **2**, **8** and **11**, respectively, arising from the homolytic fission of the C-20, C-22 bond.

The location of the carbomethoxy group on the A ring was supported by the $LiAlH_4$ reduction of **8** followed by treatment with acetone and anhydrous copper sulphate, which furnished a diacetonide (**14**). Moreover, $LiAlH_4$ reduction of **8** followed by acetylation provided a monoacetonide diacetate (**15**) In addition to the signals of the C-1, C-3, C-31 and C-22 protons, the NMR spectrum of **15** revealed the presence of an AB system at δ 3·84 and 3·78 (J = 12 Hz), which supported the location of the carbomethoxy group of **2** along an equatorial orientation [4]

Having established the gross structure of **2**, there remained to be determined the configurations at C-22 and C-24, which were studied by considering the optical properties of some derivatives of **2**

The configuration at C-22 could be defined by application of Hudson–Klyne's rule [5] to the γ-lactone obtainable by oxidation of the hemiacetal hydroxy group. However, chromic oxidation of **2** and **6** gave inseparable reaction mixtures The oxidation was successful when **6** was first subjected to catalytic hydrogenation, which afforded a dihydroderivative (**16**), $C_{32}H_{52}O_6$, whose NMR spectrum revealed the disappearance of the olefinic double bond The value of the optical rotation of the γ-lactone (**17**) in MeOH, $[\alpha]_D$ + 13·38°, and in MeOH–KOH, $[\alpha]_D$ − 10·40°, suggested the *R* configuration at C-22

The absolute stereochemistry at C-24 was assigned as *S* by use of Brewster's method [6] In fact, the *O*-benzoylation of the triacetate **3** results in a strong positive shift in rotation, $\Delta[M]_D$ + 89°

The assignment of the absolute configurations at C-22 and C-24 allows the stereochemistry of the two tetraacetates to be defined as indicated in the structures **4** and **5**. In fact, the chemical shifts of the C-22 and C-31 protons depend upon the relative orientation of the C-31 acetoxy group in respect to the C-22 and C-24 centres In the isomer **4**, the β-orientated C-31 acetoxy group induced a downfield shift on the C-21 proton signal [δ 4·44, 4·50 and 4·32 in C_6D_6, C_5D_5N and $CDCl_3$ solution, respectively], whereas the C-31 proton suffered the deshielding effect of the *cis*-orientated C-24 acetoxy group [δ 6·94, 7·05 and 6·48]. On the other hand, in the isomer **5** the α-orientation of the C-31 acetoxy group caused the C-22 and C-31 protons to resonate at higher field [δ 4·08, 4·22, 4·10 and δ 6·74, 6·85, 6·27, respectively]

No correlation of passiflorine with compounds having defined configuration was possible, but an X-ray analysis of passifloric acid methyl ester (to be reported), confirmed the presence of the 24-methylcycloartane skeleton as well as the configuration of the various asymmetric centres shown in structure **2**. In particular, the X-ray analysis indicated that only the 31*S* isomer was present in the solid state

EXPERIMENTAL

Mps are uncorrected Specific rotations were determined in C_5H_5N soln The NMR spectra were recorded at 100 MHz in C_6D_6 soln

Isolation of passiflorine The dry powdered leaves (40 Kg) were refluxed in 90% MeOH several times and the extract filtered hot, conc and diluted with H_2O The aq soln was shaken with hexane and then with EtOAc MeOH (4 1) The EtOAc extracts were evaporated to dryness and the residue chromatographed on Si gel using EtOAc EtOH–H_2O (10 1 35 1) as eluent 384 g of passiflorine (**1**) were obtained mp 183 (from MeOH) $[\alpha]_D$ + 47·1 IR ν_{max}^{Nujol} cm^{-1} 3400, 1729 (Found C 63·56 H 8·63 Calc for $C_{34}H_{60}O_{12}$ C 63·79, H, 8·62%)

Passifloric acid methyl ester (**2**) A soln of **1** (25 g) in MeOH (1 l) was treated at room temp with 12·5 ml 50% aq NaOH for 5 hr Dilution with H_2O, extraction with EtOAc and crystallization from the same solvent gave pure **2** mp 224 $[\alpha]_D$ + 78·6, IR ν_{max}^{Nujol} cm^{-1} 3490 3405 3280 1710 MS *m/e* (rel int) 548 (M^+ 11), 530 (27) 512 (25) 414 (21), 404 (18), 375 (20), 374 (22), 357 (29) 339 (25) 297 (19) 279 (20), 263 (18), 262 (21), 245 (29) 199 (38) 185 (41), 175 (40), 173 (38), 159 (51), 147 (73), 145 (71), 133 (59), 121 (80) 119 (69), 107 (100) (Found C 70·00, H, 9·60 Calc for $C_{32}H_{52}O_7$ C 70·07, H, 9·49%)

Acetylation of passifloric acid methyl ester 1·5 g of **3**, dissolved in 15 ml C_5H_5N, were treated at room temp with Ac_2O (15 ml) for 48 hr and then at 70° for 8 hr Usual work up and column chromatography (Si gel C_6H_6–EtOAc 9 1) yielded, in order of elution, **4** (135 mg, amorphous), **5** (420 mg, mp 160°, from hexane) and **3** (200 mg, mp 208°, from hexane) **4** showed the following properties $[\alpha]_D$ − 12·7° IR ν_{max}^{Nujol} cm^{-1} 1743, 1738, MS *m/e* (rel int) 657 (M − OAc, 11), 656 (10), 597 (62), 596 (60), 535 (49) 534 (87) 477 (34), 476 (35), 417 (18) 339 (50), 279 (35), 245 (26), 231 (34), 229 (29) 137 (100) **5** showed the following properties $[\alpha]_D$ + 67·4° IR ν_{max}^{Nujol} cm^{-1} 1740, MS *m/e* (rel int) 657 (M^+ − OAc 20), 656 (11), 597 (74), 596 (91) 537 (42), 536 (100), 508 (13), 494 (23), 477 (45), 339 (40) 279 (25) 255 (29) 254 (26) 241 (29) 239 (22), 185 (38) 169 (42) (Found C, 67·12, H, 8·41 Calc for $C_{40}H_{60}O_{11}$ C 67·04 H 8·38%) **3** showed the following properties $[\alpha]_D$ + 1·6 IR ν_{max}^{Nujol} cm^{-1} 3560, 1740, MS *m/e* (rel int) 615 (M − OAc, 4) 614 (7), 555 (21), 554 (43), 495 (40), 494 (100), 435 (22) 339 (22) 279 (15), 245 (22) (Found C 67·72, H 8·65 Calc for $C_{38}H_{58}O_{10}$ C, 67·66, H, 8·61%) Treatment of **3** (80 mg) with PhCOCl in boiling C_5H_5N for 3 days yielded a *benzoate* mp 172

(from petrol) (Found C, 69 37, H, 8 01 Calc for $C_{45}H_{62}O_{11}$ C, 69 41, H, 7 97)

Acidic hydrolysis of passiflorine A soln of **1** (9 g) in dioxane (500 ml) containing 5% of HCl was refluxed for 30 min After dilution with H_2O, concentration and $CHCl_3$ extraction, the aq soln was found to contain D-glucose The $CHCl_3$ extract was evaporated to dryness and the residue was treated with an excess of CH_2N_2 Column chromatography (Si gel, C_6H_6–EtOAc 7 3) yielded **6** (1 85 g) mp 208° (from MeOH), $[\alpha]_D$ + 85 4°, IR ν_{max}^{KBr} cm^{-1} 3440, 1734, MS *m/e* (rel int) 530 (M^+, 23), 512 (41) 497 (20), 494 (26), 453 (39), 435 (25), 414 (30), 396 (55), 381 (23), 337 (85), 245 (49), 185 (55), 145 (48), 131 (100) (Found C, 72 41, H, 9 48 Calc for $C_{32}H_{50}O_6$ C, 72 45, H, 9 43%) The same product was obtained if **2** was submitted to a similar acidic treatment Acetylation of **6** in C_5H_5N soln (Ac_2O, 3 days, 70°) gave **7**, mp 203°, $[\alpha]_D$ + 137 4°, IR ν_{max}^{Nujol} cm^{-1} 1740, MS *m/e* (rel int) 596 (M^+ − AcOH, 71), 581 (6), 536 (100), 521 (7), 508 (11), 494 (6), 477 (32), 461 (5), 449 (11), 435 (7), 417 (22) (Found C, 69 46, H, 8 55 Calc for $C_{38}H_{56}O_9$ C, 69 51, H, 8 54%)

Passiflonc acid methyl ester acetonide (**8**) **2** (300 mg) was suspended in 50 ml dry Me_2CO and stirred at room temp over dry $CuSO_4$ for 6 hr The acetonide **8** (92 mg) was obtained after removal of the $CuSO_4$ and column chromatography (Si gel, EtOAc–hexane 7 3) **8** showed mp 245° (from EtOAc), $[\alpha]_D$ + 71 35°, IR ν_{max}^{Nujol} cm^{-1} 3480, 3420, 1720, MS *m/e* (rel int) 588 (M^+, 8), 573 (12), 570 (7), 552 (3), 530 (7), 512 (11), 494 (6), 484 (4), 430 (6), 402 (6), 375 (11), 357 (12), 339 (8), 212 (32), 185 (100), 127 (52) (Found C, 71 41, H, 9 50 Calc for $C_{35}H_{56}O_7$ C, 71 43; H, 9 52) Diacetate (**9**), mp 218°, $[\alpha]_D$ + 108 6°

Sodium periodate oxidation of **2** $NaIO_4$ (180 mg) in H_2O was added to a soln of **2** (150 mg) in dioxane (10 ml) and the mixture kept at room temp for 12 hr The product, recovered with EtOAc, was crystallized from EtOAc–petrol to give **10**, mp 148°, $[\alpha]_D$ + 31 9°, IR ν_{max}^{Nujol} cm^{-1} 3465, 1725, 1690, 1628, MS *m/e* (rel int) 546 (M^+, 2), 528 (6), 510 (4), 500 (22), 482 (25), 467 (8), 464 (7), 415 (8), 375 (21), 357 (43), 339 (31), 325 (12), 297 (16), 279 (19), 126 (100). (Found C, 70 28, H, 9 19 Calc for $C_{32}H_{50}O_7$ C, 70 33, H, 9 16%) A soln of **10** (56 mg) in MeOH (6 ml) was treated for 15 min with KOH (50 mg) Dilution with H_2O, neutralization with HCl, extraction with EtOAc and crystallization from Me_2CO yielded **13** (30 mg), mp 194°, $[\alpha]_D$ + 57°, λ_{max}^{MeOH} nm 229 (1 g ϵ 4 18), IR ν_{max}^{Nujol} cm^{-1} 3580, 3490, 3300, 1725, 1690, 1628, MS *m/e* (rel int) 500 (M^+, 7), 482 (18), 464 (9), 449 (4), 432 (4), 423 (4), 405 (5), 375 (20), 357 (37), 339 (26), 325 (10), 297 (11), 280 (15), 126 (100) (Found C, 74 34, H, 9 67 Calc for $C_{31}H_{48}O_5$ C, 74 40, H, 9 60%)

Passiflonc acid methyl ester methyl ether (**11**) **1** (100 mg) was dissolved in MeOH (5 ml) containing 5% of gaseous HCl After 2 hr, the soln was neutralized with Dowex^{-3} and evaporated to dryness Crystallization of residue from petrol yielded **11**, mp 189°, $[\alpha]_D$ + 57 9°, IR ν_{max}^{Nujol} cm^{-1} 3440, 1720, MS *m/e* (rel int) 562 (M^+, 4), 544 (6), 530 (22), 512 (24), 487 (14), 430 (12), 429 (11), 375 (11), 358 (16), 357 (16), 339 (13), 186 (37), 159 (100) (Found C, 70 44, H, 9 58 Calc for $C_{33}H_{54}O_7$ C, 70 46, H, 9 61%) If the acidic alcoholic soln was directly evaporated to dryness and the residuue crystallized from MeOH, **12** was obtained, mp 169°, $[\alpha]_D$ + 62 5° IR ν_{max}^{Nujol} cm^{-1} 3410, 1738, MS *m/e* (rel int) 544 (M^+, 32), 526 (38), 513 (9), 497 (8), 494 (7), 485 (10), 484 (12), 467 (49), 407 (14), 245 (18), 159 (100) (Found C, 72 84; H, 9 61 Calc for $C_{33}H_{52}O_6$ C, 72 79, H, 9 56%)

$LiAlH_4$ reduction of passiflonc acid methyl ester acetonide **8** (140 mg) was dissolved in dry THF (20 ml) and treated with $LiAlH_4$ under standard conditions A portion (48 mg) of the product obtained was treated with Me_2CO (20 ml) and dry $CuSO_4$ (200 mg) for 3 hr After removal of the $CuSO_4$, diacetonide **14** (32 mg) was obtained in pure form by column chromatography (Si gel, eluent C_6H_6), mp 183° (from petrol), $[\alpha]_D$ + 82 3° (Found C, 73 93, H, 9 96 Calc for $C_{37}H_{60}O_6$ C, 74 00, H, 10 00%) Acetylation of the second portion (C_5H_5N, room temp, 24 hr) yielded **15**, mp 196° (from EtOAc), $[\alpha]_D$ + 37 2° (Found C, 70 03, H, 9 01 Calc for $C_{40}H_{62}O_9$ C, 69 97, H, 9 04%)

CrO_3 oxidation of the methyl ester **6** **6** (70 mg) was treated in AcOH (80 ml) for 5 days with H_2 and PtO_2 (300 mg) The dihydroderivative **16** showed mp 263° (from EtOAc), $[\alpha]_D$ + 74 5°, MS *m/e* (rel int) 532 (M^+, 10), 514 (6), 500 (6), 475 (9), 472 (11), 334 (100), 319 (52), 316 (51), 301 (35), 291 (30), 250 (49) **16** (50 mg) was treated for 3 days at 0° with CrO_3 (100 mg) in C_5H_5N soln (5 ml) Dil with H_2O, extraction with EtOAc and crystallization from EtOAc yielded **17** (28 mg), mp 275°, $[\alpha]_D$ + 13 38 (MeOH), IR ν_{max}^{Nujol} cm^{-1} 3490, 3350, 1784, 1733, 1695, MS *m/e* (rel int) (M^+, 14), 471 (8), 470 (7), 332 (100), 317 (48) (Found C, 72 47, H, 9 39 Calc for $C_{32}H_{50}O_6$ C, 72 45, H, 9 43%)

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