Phytochemistry, 1971, Vol 10, pp 1351 to 1354 Pergamon Press Printed in England

TRITERPENES OF THE STEM-BARK OF *ARTOCARPUS CHAPLASHA*

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(*Received* 19 *August* 1970)

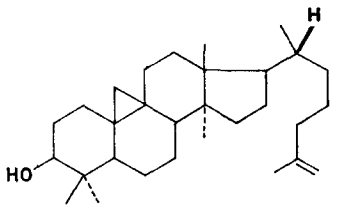
Abstract—From the stem-bark of *Artocarpus chaplasha* lupeol acetate, cycloartenyl acetate, β-sitosterol and a new triterpene, isocycloartenol (as acetate) have been isolated Isocycloartenol has been shown to be 9 19-cyclolanost-25-en-3β-ol(I)

INTRODUCTION

ARTOCARPUS plants (Moraceae), which are rich in triterpenes, have already been studied in this laboratory.[1–4] In the Indian indigenous system of medicine, *Artocarpus lakoocha* and *Artocarpus integrifolia* have some recognition whilst the wood of *A. chaplasha* is used commercially as timber.[5] This paper reports an account of the triterpenes of the stem-bark of *A. chaplasha* Roxb.[3]

RESULTS

A petroleum extract of the bark of *A. chaplasha*, on repeated chromatography over alumina, yielded a new triterpene, isocycloartenyl acetate along with lupeol acetate, cycloartenyl acetate and β-sitosterol. Separation of isocycloartenyl acetate from its companion cycloartenyl acetate is very difficult and repeated chromatography is necessary; cycloartenyl acetate moves a little faster than isocycloartenyl acetate. This is the first report of the isolation of cycloartenol as the acetate from a natural source.



Isocycloartenol (I)

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[1] S. B. MAHATO, S K BANERJEE and R. N CHAKRAVARTI, *Bull. Calcutta School Trop. Med.* **14**, 16 (1966).
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[3] S. B. MAHATO, S K. BANERJEE and R N. CHAKRAVARTI, *Bull Calcutta School Trop. Med.* **15**, 138 (1967).
[4] S B. MAHATO, S K. BANERJEE and R. N CHAKRAVARTI, *Bull Calcutta School Trop Med* **16**, 48 (1968).
[5] COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, in *The Wealth of India* (edited by B. L MANJUNATH), Vol I, p 124, New Delhi (1948)

Isocycloartenyl acetate, $C_{32}H_{52}O_2$, m p. 112–113° on hydrolysis with ethanolic KOH furnished the parent alcohol, isocycloartenol, $C_{30}H_{50}O$, m.p. 92–93°. The latter contains a methylene group in a cyclopropane ring, as is evident from an absorption band at 3045 cm^{-1} in the i.r. spectra of isocycloartenol and its acetate, benzoate and of the corresponding ketone, isocycloartenone. A pair of doublets in the NMR spectrum of isocycloartenol centered at δ 0·33 and δ 0·55 indicate the presence of two diastereomeric protons in the cyclopropane ring. The mass spectrum shows a peak at *m/e* 286, which is typical of a 9.19-cyclopropane ring.[6] The presence of an easily reducible double bond in isocycloartenol is indicated by the fact that on catalytic hydrogenation isocycloartenyl acetate takes up one mole of hydrogen. Isocycloartenol on oxidation with chromium trioxide in acetic acid or on Oppenauer oxidation affords a ketone, isocycloartenone, $C_{30}H_{48}O$. The ketone gives a positive Zimmermann test, indicating the presence of a 3-oxo-group. The ketone can be reduced back by sodium-*n*-propanol to the parent alcohol, isocycloartenol. This result in addition to the presence of a peak at 1040 cm^{-1} in the i.r. spectrum of isocycloartenol indicates the equatorial conformation of the hydroxyl group in the compound. The changes in molecular rotation on acetylation and benzoylation of isocycloartenol are also in conformity with those of a 3β (equatorial) hydroxyl group in a triterpene.

Moreover, isocycloartenyl acetate on catalytic hydrogenation gives cycloartanyl acetate, and isocycloartenone yields cycloartanone similarly. These results indicate that isocycloartenol differs from cycloartenol only in the position of the double bond. That isocycloartenol contains a terminal double bond (=CH_2) is indicated from the absorption at 890 cm^{-1} in the i.r. spectra of the product and its derivatives (acetate, benzoate and the ketone). Moreover, the NMR spectrum of the compound shows no signals attributable to two methyl groups attached to C_{25} as in cycloartenol. It does have a peak at δ 1·73 corresponding to one methyl group located on an olefinic bond. Formation of formaldehyde on ozonolysis of isocycloartenyl acetate confirms the presence of a terminal double bond.

Furthermore, isocycloartenyl acetate on treatment with dry HCl gas in chloroform yields a hydrochloride identical with lanostadienyl acetate hydrochloride, which is also formed when cycloartenyl acetate is treated with dry HCl in the similar way.

Thus, the above evidence shows that isocycloartenol is 9,19-cyclolanost-25-en-3β-ol(I).

EXPERIMENTAL

Petroleum used had b p. 40–60°. M ps are uncorrected I.r. spectra were recorded as Nujol mulls. NMR spectra were obtained with $CDCl_3$ as solvent and TMS as internal standard.

Extraction Procedure

Soxhlet extraction of the powdered stem-bark (1 8 kg) of *Artocarpus chaplasha* Roxb. with petroleum for 40 hr and subsequent removal of the solvent yielded a dirty yellow gummy residue (35 g) which was chromatographed on a column of neutral Brockmann alumina (1 kg), elution being carried out successively with petroleum, various mixtures of petroleum–benzene, benzene and benzene–ether mixture (1:1). This gave *fraction* 1 (eluted with petrol) (13 1 g), *fraction* 2 (eluted with petrol–benzene mixtures and benzene) (5 3 g) and *fraction* 3 (eluted with benzene–ether (1 1)) (2 1 g).

Fraction 1 was rechromatographed over alumina (400 g) and the fractions were again divided in three fractions, an early (A), middle (B) and later fraction (C), using petroleum as eluent.

Isolation of Lupeol Acetate and Cycloartenyl Acetate

Fraction (A) was chromatographed on alumina when it separated into two pure components (by TLC). The first component on crystallization from ethanol yielded lupeol acetate in needles (0·93 g), m.p. 216–217° (undepressed on admixture with authentic sample), $[\alpha]_D^{25}$ +39 6° ($CHCl_3$); i r. 1740, 1380, 1242, 885 cm^{-1}

[6] H. E. AUDIER, R. BENGELMANS and B. C. DAS, *Tetrahedron Letters* 4341 (1966).

(Found. C, 81 82, H, 11 23. Calc. for $C_{32}H_{52}O_2$: C, 81 99; H, 11·18%.) The second component on crystallization from ethanol afforded cycloartenyl acetate (1·47 g) in needles (giving cycloartenol, m.p. 90–95° and acetic acid on hydrolysis), m.p 118–120°, $[\alpha]_D^{25}$ +57° ($CHCl_3$), i.r. 3042, 1740, 1380, 1240, 840 cm^{-1}. (Found C, 81·71; H, 11 27. Calc. for $C_{32}H_{52}O_2$· C, 81 99, H, 11 18%.)

Isolation of Isocycloartenol

Fraction (B) was again chromatographed on alumina when a further crop of cycloartenyl acetate was obtained from the early fractions. The later fractions here were mixed with fraction (C) and chromatographed when again a further crop of cycloartenyl acetate and isocycloartenyl acetate (0 59 g) were obtained.

Isocycloartenyl acetate was crystallized from ethanol m p. 112–113°, $[\alpha]_D^{25}$ +53 8° ($CHCl_3$); i.r. 3045 (CH_2 of cyclopropane ring), 1740, 1240 (acetate carbonyl), 890, 1638 (=CH_2), 1378 cm^{-1} (C-Me) The mass spectrum showed the molecular ion of *m/e* 286; NMR: δ 0·33 and 0 55 (cyclopropane methylene), δ 1 73 (one methyl group on olefinic bond) ppm. (Found: C, 81·73, H, 11 11, $C_{22}H_{52}O_2$ required· C, 81 99, H, 11 18%)

Hydrolysis of Isocycloartenyl Acetate

Isocycloartenyl acetate (150 mg) was refluxed with 5% ethanolic KOH (15 ml) for 2 hr. This afforded (after recrystallization from MeOH–$CHCl_3$ (4:1)) *isocycloartenol* as needles (110 mg), m p. 92–94°, $[\alpha]_D^{25}$ +44 9° (Found: C, 84 32; H, 11 68, $C_{30}H_{50}O$ required C, 84 44; H, 11 81%.) The aqueous alkaline solution left after extraction of isocycloartenol on distillation with H_2SO_4 gave acetic acid.

Isocycloartenol Benzoate

Isocycloartenol (50 mg) on benzoylation with benzoyl chloride-pyridine in the usual way yielded *isocycloartenyl benzoate* in needles (4 mg), m p. 121–122°, $[\alpha]_D^{25}$ +58 8° ($CHCl_3$) (Found· C, 83 56; H, 10 12. $C_{37}H_{54}O_2$ required: C, 83·72; H. 10·25%)

Catalytic Hydrogenation of Isocycloartenyl Acetate

Isocycloartenyl acetate (100 mg) was hydrogenated with shaking for 3 hr in HOAc (50 ml) in the presence of PtO_2 (40 mg) until no more H_2 was absorbed. The product, on crystallization from methanol, afforded cycloartenyl acetate as needles (80 mg), m p. 131–132° (undepressed on admixture with authentic cycloartanyl acetate prepared from cycloartenyl acetate), $[\alpha]_D^{25}$ +56°, C, 81 64; H, 11 56%.

Isocycloartenone

Isocycloartenol (200 mg), acetone (A.R quality) (3 ml) and dry benzene (4 ml) were heated to boiling. Then a solution of aluminium isopropoxide (500 mg) in dry benzene (6 ml) was added and the mixture heated under reflux. The product, on chromatography over alumina followed by crystallization from MeOH–$CHCl_3$, afforded *isocycloartenone* as shining needles, (110 mg), m.p 99–100°, $[\alpha]_D^{25}$ +19 6° ($CHCl_3$) i.r. 3042, 1708, 1640, 1380, 890 cm^{-1}. (Found: C, 84·76; H, 11 28%) Isocycloartenone was also prepared by treating isocycloartenol with CrO_3 in acetic acid–water–benzene in the usual way.

Ozonolysis of Isocycloartenyl Acetate

Through a solution of isocycloartenyl acetate (200 mg) in dry $CHCl_3$ (20 ml), kept in ice, was passed ozonized oxygen for 4 hr. The $CHCl_3$ was removed at reduced pressure, and residue decomposed with water (20 ml) on a water bath, and the volatile product was swept into an acidic solution of 2:4-dinitrophenylhydrazine (0·1%, 1 ml) by a current of N_2. The yellow ppt, was separated by filtration, washed free from acid and dried. This had m.p. 166° (undepressed on admixture with an authentic sample of DNP of formaldehyde). Ozonolysis of cycloartenyl acetate, carried out for comparison, yielded, however, acetone characterized as the DNP.

Treatment of Isocycloartenyl Acetate with HCl

Isocycloartenyl acetate (50 mg) in $CHCl_3$ (8 ml) was treated with gaseous HCl at room temperature for 30 min. Removal of the solvent in vacuum and crystallization of the residue from MeOH–$CHCl_3$ gave lanostadienyl acetate hydrochloride[7,8] (25 mg), m p. 169–170°, $[\alpha]_D^{25}$ +62° ($CHCl_3$). (Found: C, 76·25; H, 10·56. Calc. for $C_{32}H_{53}O_2Cl$: C, 76 05; H, 10·60%.) The same product was obtained from cycloartenyl acetate on similar treatment

[7] D. H. R. Barton, *J Chem. Soc.* 1444 (1951).
[8] H. R. Bentley, J. A. Henry, D. S. Irvine and F. S. Spring, *J. Chem. Soc.* 3673 (1953).

Isolation of β-Sitosterol

Fraction 3. From the chromatography of the petroleum extract of *A chaplasha* on chromatography over alumina yielded β-sitosterol, m p 137–138° (undepressed on admixture with authentic sample), $[\alpha]_D^{25}$ −41° ($CHCl_3$)

Acknowledgements—We wish to thank the Director, National Chemical Laboratory, Poona for the *i* r. and the mass spectra. Our thanks are also due to the Director, Central Drug Research Institute, Lucknow for the NMR spectra