Phytochemistry, 1971, Vol. 10, pp. 1665 to 1667. Pergamon Press. Printed in England.

SHORT COMMUNICATION

CHROMENES FROM *EUPATORIUM RIPARIUM*

D. R. TAYLOR and J. A. WRIGHT
Chemistry Department, University of the West Indies, Kingston 7, Jamaica

(*Received* 5 *October* 1970)

Abstract—Jamaican *E. riparium* Regel has been examined and found to contain the new chromene acetovanillochromene (6-acetyl-8-methoxy-2,2-dimethylchromene) as well as methyl-ripariochromene A (6-acetyl-7,8-dimethoxy-2,2-dimethylchromene) previously isolated from an Australian sample of the same species. Confirmation of the structure of methylripariochromene A is reported.

BOTH benzofurans[1] and, more recently, chromenes[2] have been isolated from *Eupatorium* species. Anthonsen has reported[2] the isolation of four new chromenes from Australian *E. riparium* Regel. We now report the isolation from Jamaican *E. riparium* Regel of a new chromene as well as one of those previously found.

The major chromene, isolated by column and preparative TLC as an oil, $C_{15}H_{18}O_4$, has IR absorption at 1665 cm^{-1} and formed a red 2,4-dinitrophenylhydrazone. The NMR spectrum (see Table 1 for all NMR spectral data) which revealed the presence of a 2,2-dimethylchromene system, an acetyl and two methoxy groups, and an aromatic proton, was identical with that of methylripariochromene A (I).[2] The structure of (I) was deduced[2] from the NMR spectral data. We now provide confirmation of (I).

TABLE OF NMR DATA*

Compound	H-3	H-4	Ar	Acetyl	$OC\underline{H}_3$	$—C(C\underline{H}_3)_2$	Others
I	5·61	6·33	7·25	2·57	3·88, 3·98	1·48	
II	1·81	2·78	7·37	2·60	3·88, 3·98	1·41	
III	1·78	2·75	6·85	—	3·84, 3·92	1·36	$O\underline{H}$ 2·30, $C\underline{H}OH$ 5·03 $C\underline{H}_3CH$ 1·47
V	—	—	7·91	2·60	3·76, 3·83 3·86, 3·98	1·56	
VI	5·68	6·37	7·28 7·45	2·54	3·92	1·51	

* Chemical shifts are in ppm from internal tms for $CDCl_3$ solutions

Hydrogenation of (I) gave two products, (II) and (III), whose structures were apparent from their NMR spectra. The large upfield shift in the aromatic proton between (II) and (III) shows that it must be *ortho* to the acetyl group in (II). Potassium permanganate oxidation of (I) gave the diacid (IV). The marked downfield shift of the aromatic proton in the NMR spectrum of the dimethylester (V) requires that the carbomethoxy group attached directly to the benzene ring be *ortho* to the aromatic proton. These data fully

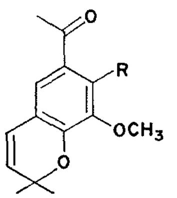
---

[1] F. M. DEAN, *Naturally Occurring Oxygen Ring Compounds*, Butterworths, London (1963).

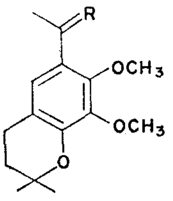
[2] T. ANTHONSEN, *Acta Chem. Scand.* **23**, 3605 (1969).

define the structure (I) for methylripariochromene A. Final confirmation was achieved by the formation of gallacetophenone on treatment of the diacid (IV) with hydrobromic acid.

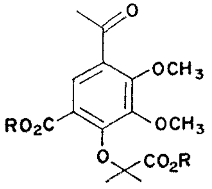
Another chromene, acetovanillochromene, $C_{14}H_{16}O_3$, (VI) was isolated in low yield. The NMR spectrum showed the 2,2-dimethylchromene system, an acetyl and a methoxy group and two *meta* coupled aromatic protons. The presence of the conjugated carbonyl group was confirmed by the IR absorption at 1670 cm^{-1} and the formation of a red 2,4-dinitrophenylhydrazone. The chemical shifts of the aromatic protons indicate that they are both *ortho* to the acetyl group and the shift of H-4 suggests that C-5 is unsubstituted.[2] These data lead to the structure (VI) for acetovanillochromene and this was confirmed by synthesis from acetovanillone by the method of Hlubucek, Ritchie and Taylor.[3]



I R = OCH_3
VI R = H



II R = O
III R = H,OH



IV R = H
V R = CH_3

EXPERIMENTAL

Extraction

Dried, milled *Eupatorium riparium* Regel (1·85 kg) was percolated with benzene (4 l.). Evaporation of the solvent yielded a gum (72 g). Chromatography of the gum (24 g) over aluminium oxide (Merck grade II–III, 490 g) and elution with light petroleum–benzene (1:4) and benzene gave a fraction (5·0 g) which was mainly one compound by TLC. Purification by preparative TLC in benzene–$CHCl_3$ (1:1; two developments) afforded methylripariochromene A (I) (3·2 g) λ_{max} 254 and 287 nm (ϵ 23,650 and 8370), ν_{max} 1665 cm^{-1} (Found: C, 68·85; H, 6·9; O, 24·35%. Calc. for $C_{15}H_{18}O_4$: C, 68·7; H, 6·9; O, 24·4%.) The 2,4-*dinitrophenylhydrazone*, red needles from MeOH, had m.p. 138–139° (Found: C, 56·8; H, 4·95; N, 12·6; O, 25·5%. $C_{21}H_{22}N_4O_7$ required: C, 57·0; H, 5·0; N, 12·7; O, 25·3%.)

Elution of the column with benzene and benzene–ethyl acetate mixtures gave a fraction (3·2 g) which contained more methylripariochromene A (TLC). Preparative TLC in benzene-$CHCl_3$ (1:1) gave a band (500 mg) shown by its NMR spectrum to contain methylripariochromene A and another chromene. Separation by preparative TLC in benzene (seven developments) yielded methylripariochromene A (100 mg) and *acetovanillochromene* (VI) (60 mg), λ_{max} 237, 245, 263 and 307 nm (ϵ 16,200, 16,700, 16,850, 6300) ν_{max} 1670 cm^{-1} (Found: C, 72·6; H, 7·0%. $C_{14}H_{16}O_3$ required: C, 72·4; H, 6·9%.) The 2,4-*dinitrophenylhydrazone*, red needles from MeOH, had m.p. 203–204° (Found: C, 58·4; H, 5·1; N, 13·5%. $C_{20}H_{20}N_4O_6$ required: C, 58·3; H, 4·85; N, 13·6%.)

Hydrogenation of Methylripariochromene A

Methylripariochromene A (210 mg) was hydrogenated over prereduced 10% Pd/C (300 mg) until the uptake ceased (1·3 mole). The product was separated by preparative TLC into two compounds.

The major product, *dihydromethylripariochromene A* (II) (133 mg) had λ_{max} 220 and 280 nm (ϵ 6000 and 4250), ν_{max} 1665 cm^{-1} (Found: C, 68·0; H, 7·9; O, 24·0%. $C_{15}H_{20}O_4$ required: C, 68·2; H, 7·6; O, 24·2%.) The 2,4-*dinitrophenylhydrazone*, red needles from MeOH, had m.p. 164–165° (Found: C, 56·5; H, 5·4; N, 12·7; O, 25·1%. $C_{21}H_{24}N_4O_7$ required: C, 56·8; H, 5·4; N, 12·6; O, 25·2%.)

The minor product, *tetrahydromethylripariochromene A* (III) (69 mg), had λ_{max} 228 and 284 nm (ϵ 8400 and 1250) ν_{max} 3350 cm^{-1} (Found: C, 66·8; H, 8·3%. $C_{15}H_{22}O_4$ required: C, 67·6; H, 8·3%.)

---

[3] J. Hlubucek, E. Ritchie and W. C. Taylor, *Tetrahedron Letters* 1369 (1969).

Potassium Permanganate Oxidation of Methylripariochromene A

Powdered $KMnO_4$ (7·3 g) was added over 6 hr to methylripariochromene A (1·27 g) in acetone (100 ml) under reflux. The volume was reduced to about 10 ml, H_2O (150 ml) added and the mixture decolourized with SO_2. The *diacid* (IV), isolated by extraction into ethyl acetate, crystallized from ethyl acetate–light petroleum (850 mg) m.p. 164–166°, λ_{max} 233, 262 and 308 nm (ϵ 30,000, 13,250 and 2170) ν_{max} 2640, 1712 and 1685 cm^{-1} (Found: C, 55·2; H, 5·6; O, 39·2%. $C_{15}H_{18}O_8$ required: C, 55·2; H, 5·6; O, 39·2%.) The *dimethylester* (V), prepared with CH_2N_2, was a gum, ν_{max} 1725 and 1675 cm^{-1}.

Formation of Gallacetophenone from the Diacid (IV)

The diacid (IV) (453 mg) was heated under reflux in HBr (*d* 1·48; 20 ml) for 90 min. Dilution with H_2O and extraction into ethyl acetate gave a residue (158 mg) which on preparative TLC in benzene–methanol–acetic acid (45:8:4) yielded gallacetophenone (13 mg), m.p. 166–168° (from benzene), identical with authentic material by TLC, m.p., and mixed m.p.

Synthesis of Acetovanillochromene (VI)

Acetovanillone[4] (75 mg), 3-chloro-3-methyl-1-butyne[5] (986 mg) and Ag_2O (448 mg) were heated under reflux in anhydrous acetone. After 24 hr the products were isolated by filtration and evaporation of the solvent. Purification of the residue by preparative TLC gave a mixture of the α,α-dimethylpropargylether and acetovanillochromene (48 mg; approximately 6:4 by NMR). The mixture was heated at 140–150° for 1 hr to produce acetovanillochromene (45 mg) shown to be identical with the natural product by TLC, IR, UV and NMR spectral comparison and by comparison of their 2,4-dinitrophenylhydrazones.

---

[4] T. Reichstein, *Helv. Chim. Acta* **10**, 392 (1927).

[5] G. F. Hennion, J. J. Sheehan and D. E. Maloney, *J. Am. Chem. Soc.* **72**, 3542 (1950).