Tetrahedron. Vol. 27, pp. 981 to 984. Pergamon Press 1971. Printed in Great Britain

A NEW CHROMONE FROM *CASSIA SIAMEA**

S. ARORA,† H. DEYMANN,‡ R. D. TIWARI† and E. WINTERFELDT‡

(*Received in Germany* 15 *September* 1970; *Accepted for publication* 16 *October* 1970)

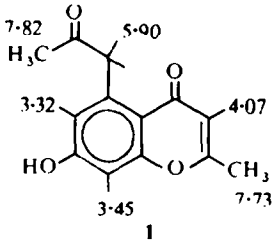
Abstract—The chromone **1** has been isolated from the flowers of *Cassia siamea* and its structure elucidated from spectral data and chemical transformations.

AN EXTRACT from dry *Cassia siamea* flowers yielded yellowish-green crystals which after repeated crystallisation melted at 210° and proved on thin-layer chromatography in different solvent systems to be a single substance. As the pure compound showed considerable antibiotic activity against gram-negative organisms§ its structure was investigated.

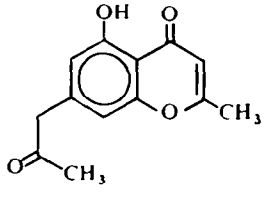
The molecular formula $C_{13}H_{12}O_4$ emerged from analytical data and is supported by the molecular weight from high-resolution mass spectrometry (see Experimental) Other interesting features of the mass-spectrum are a base peak at 190 m/e and a metastable-ion at 155 m/e, corresponding to the loss of ketene (42 mass-units). The conversion of this 190 m/e-ion to a fragment of 162 m/e by loss of carbon monoxide is inferred from another metastable ion at 138 m/e. In the lower mass region an intense 43 m/e-fragment is in accord with an acetyl side chain.

This latter conclusion is supported by the NMR-spectrum which has a three proton singlet at 7·82 τ (3). Further signals appear at 7·73 τ (3), slightly split to a doublet; 5·90 τ (2) s; 4·07 τ (1), very narrow quartet; and two meta-coupled ($J = 2$) aromatic protons at 3·45 τ (1) and 3·32 τ (1). The chemical shift of the latter two protons indicate the phenolic nature of the material under investigation.

Infrared absorptions at 3300, 1730, 1650, 1630, 1600, 1580 and 1505 cm^{-1} confirm these results and UV-maxima at 290, 249 and 251 mμ exclude a coumarin-type-structure as the UV-absorption of any hydroxy-coumarin of this type should be expected at higher wavelengths.[1]



1



2

* Presented in part at the second Indo-Soviet Symposium on the Chemistry of natural products, Delhi, February 1970

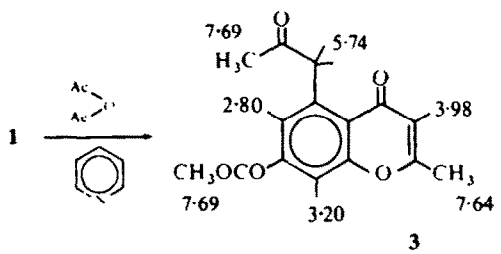
† Chemistry Department, Allahabad University, Allahabad, India

‡ Organisch-Chemisches Institut, Technische Universität, Hannover, Germany

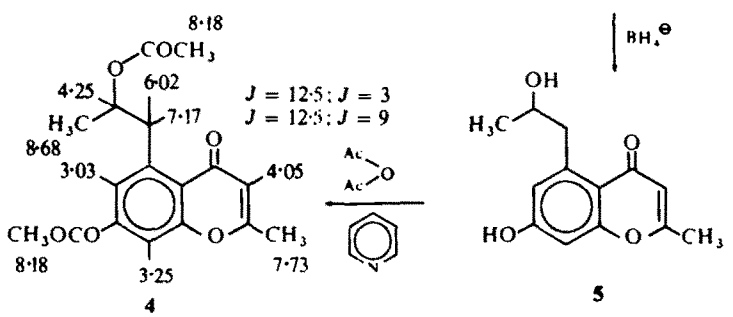
§ As examined in the Department of Pathology, Medical College, Allahabad, India.

Structures **1** and **2** are compatible with the spectral data, **1** being favoured on account of the appearance of the two-proton singlet for the benzylic-protons at rather low field, which would be accounted for by carbonyl-deshielding in **1**.

Chemical transformations confirmed structure **1**. An acetate is formed in high yield on treatment with pyridine and acetic anhydride which has a six-proton singlet in its NMR-spectrum at 7·69 τ (see formula) and the typical carbonyl band of a phenol-acetate at 1770 cm^{-1}.



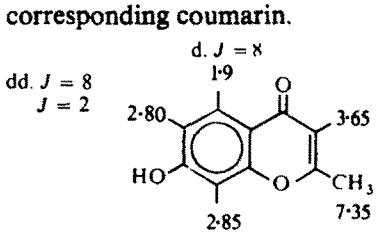
3



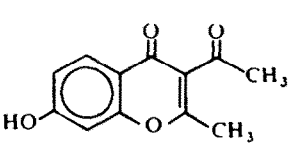
4 **5**

While borohydride reduction of the original product gave only a poor yield of reduced material, borohydride reduction of this acetate (**3**), and subsequent reacetylation afforded the diacetate **4** in high yield. NMR-data confirmed structure **4** (see formula). As a center of chirality has been introduced, the two benzylic protons now appear as a widely separated AB-quartet with quite different coupling constants. The deshielding effect of the chromone carbonyl-group on the different protons obviously differs considerably.

With all this information definitely proving structure **1**, it was very disappointing to note that the UV-spectrum recorded in the literature[2] for 7-hydroxy-2-methyl-chromone **6** did not match the UV-spectrum of our natural product. An additional maximum at 340 mμ indicated an impurity in the reported material, very probably the corresponding coumarin.



6



7

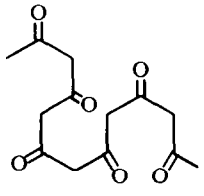
When the preparation of **6**, following the Kostanecki-Robinson method used by Sen and Bagghi,[2] was repeated the UV-spectrum of the crystalline reaction product, obtained immediately after work up, was very similar to the one cited in the literature. But thin-layer chromatography proved this material to be a mixture of three products, one of them probably the coumarin, judged from the yellow colour of the spot.

The most polar fraction, representing the main reaction product, was separated by preparative thin-layer chromatography and after sublimation showed UV-absorption identical with the natural product (see Fig 1).

A NMR-spectrum of this material (data, see formula) secured structure **6**, thus proving the 7-hydroxy-chromone-chromophore of **1** beyond any doubt.

The least polar fraction proved to be the C-acylated product **7**, indicating that longer saponification of the raw condensation product is necessary to get pure chromones. As expected this substance gave rise to **6** on further treatment with sodium carbonate solution on the steam-bath.

In conclusion it is tempting to speculate on the biosynthesis of **1** which could be by a cyclisation process *via* a polyketide chain such as **8**.

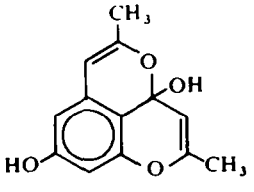


8

Although a number of alkylated chromones are now known, especially those with isoprene-units attached to positions on the aromatic nucleus, usually *ortho* to a hydroxyl-group, to the best of our knowledge no chromones have been reported with an acetonyl side-chain in the 5-position, *meta* to the hydroxyl-group.

As other chromones of similar type are present in the plant, though in a very small amount, structurally related to **1**, a general synthesis for compounds of this type is under active investigation. Material secured in this way could also be used for further testing the antibiotic activity of these substances in relation to their structure.

* After the preparation of this manuscript Bycroft and his coworkers[3] reported on the structure of Barakol (**a**) and its easy transformation into the chromone **1**, as well as the regeneration of Barakol by acid treatment of **1**. A sample of Barakol kindly provided by Professor Bycroft was shown to be identical in every detail with the product of acid-treatment of our chromone. As chromone **1** was isolated from the same plant as Barakol under neutral conditions both substances must be derived from the polyketide-chain, but there is no indication of the biogenetic priority.



9

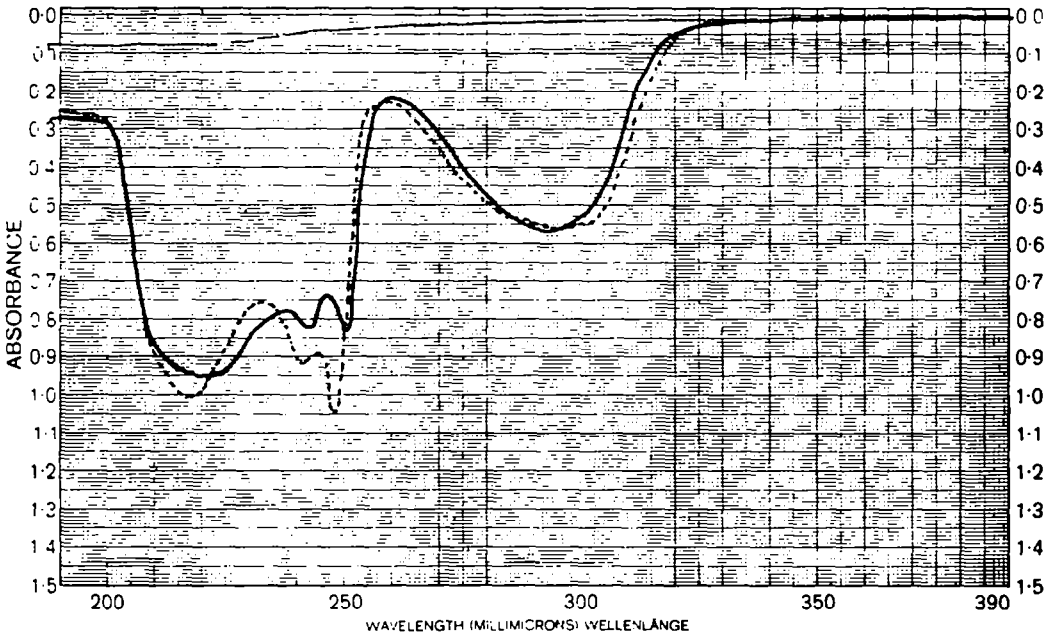


FIG 1. UV-spectrum of **1** (———) and of 7-hydroxy-2-methyl-chromone **6** (---)

EXPERIMENTAL

Cassia siamea flowers, dry and powdered (2 kg) after continuous light petroleum extraction, were extracted with boiling EtOH till a colourless extract was obtained. After concentration under reduced pressure the residue was poured into distilled water, filtered, concentrated and then extracted with light petroleum. The remaining water was continuously extracted with Et_2O. This extract was concentrated and on standing over-night yielded a yellowish-green deposit. After crystallisation from acetone 300 mg yellow crystals were obtained m.p. 210° (MeOH) λ_{max}^{MeOH}: 293 (11,400) 251, (16,400), 243 (16,100), 221 (18,000); $\nu_{max}^{CHCl_3}$: 3300, 1730, 1650, 1630, 1600, 1580, 1505, 1160, 1110 cm^{-1}; $NMR_{100mc}^{CDCl_3}$: 3·32 (1) d, $J = 2$; 3·45 (1) d, $J = 2$; 4·07 (1) s, broad; 5·90 (2) s; 7·73 (3) s, broad; 7·82 (3) s; m/e: 232 (30%), 190 (100%), $m^* = 155$; 162 (9%), $m^* = 138$; 161 (10%), 43 (25%). $C_{13}H_{12}O_4$ calc 232.0735; exp 232.0726. (Found: C, 67·08; H, 5·36. $C_{13}H_{12}O_4$ requires: C, 67·24; H, 5·17%).

Acetylation. 100 mg of natural product were heated in 5 ml dry pyridine and 5 ml Ac_2O for 4 hr on the steam bath, poured into ice-water and extracted with CH_2Cl_2. After evaporation under reduced pressure the residue was crystallised from Et_2O- it melted at 132°.

λ_{max}^{MeOH}: 298, 260, 244 sh, 223 mμ; $\nu_{max}^{CHCl_3}$: 1730, 1660, 1620 cm^{-1}; $NMR_{100mc}^{CDCl_3}$: 2·8 (1) d, $J = 2$; 3·2 (1) d, $J = 2$; 3·98 (1) broad; 5·74 (2) s; 7·64 (3) broad; 7·69 (6) s; (Analysis- found: C, 65·95; H, 5·22. $C_{15}H_{14}O_5$ requires: C, 65·68; H, 5·14%).

Borohydride reduction. 100 mg of acetate **3** were dissolved in 5 ml MeOH and treated with 50 mg $NaBH_4$ for 10 min at room temp. After treatment with dil HCl and extraction with Et_2O the residue, after evaporation under reduced pressure, was acetylated as above and yielded the dihydroacetate **4**, m.p. 84° from Et_2O.

λ_{max}^{MeOH}: 298, 260, 240 sh, 220 mμ; $\nu_{max}^{CHCl_3}$: 1780, 1745, 1665, 1620 cm^{-1}; $NMR_{100mc}^{CDCl_3}$: 3,03 (1) d, $J = 2$; 3·25 (1) d, $J = 2$; 4·05 (1) broad; 6·02 (1) dd, $J = 12·5$, $J = 3$; 7·17 (1) dd, $J = 12·5$, $J = 9$; 7·73 (3) broad; 8·18 (3) s; 8·68 (3) s.

REFERENCES

[1] A. I. Scott, *Interpretation of the ultraviolet spectra of natural products*, Pergamon Press (1964)

[2] K. Sen and P. BagChi, *J. Org. Chem.* **24**, 316 (1959)

[3] B. W. Bycroft, A. Hassaniali-Walji, A. W. Johnson and T. J. King, *J. Chem. Soc.* (*London*) *C* 1686 (1970)