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ALKALOIDS OF *GLYCOSMIS ARBOREA*—III[1]

STRUCTURE OF ARBORININE

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Abstract—Arborinine is identical with the 2,3-dimethoxy-1-hydroxy-10-methylacridone of Hughes *et al.*

ARBORINE and arborinine were isolated[6–8] from the leaves of *Glycosmis arborea* Correa and the structure of the major alkaloid, arborine, was established[1,9,10] as 2-benzyl-1-methylquinazol-4-one by Chakravarti *et al.* Aborinine crystallizes in yellow needles, m.p. 175–176°, and gives a deep green coloration with alcoholic ferric chloride.[11] It was found[10] to have the molecular formula, $C_{16}H_{15}O_4N$. The value obtained for N-methyl indicated the presence of one such group, but that for methoxy was somewhat higher than that for one OMe. Arborinine was found to be optically inactive.[10]

In a recent short communication by Pakrashi *et al.*[14] arborinine was identified with a known product, 2,3-dimethoxy-1-hydroxy-10-methylacridone (I), prepared synthetically by Hughes *et al.*[15,16] and later isolated from *Evodia alata.*[17] The same result was also obtained independently by the present authors, although for various reasons the present communication has been delayed.[18] However, as the lines of approach are different the details of the results obtained are being reported.

On re-examination of the composition of arborinine it was observed that it has two methoxy groups in addition to one N-methyl group and one active hydrogen. It gives arborinine acetate, $C_{18}H_{17}O_5N$, having two methoxy, one N-methyl and one acetyl groups, and arborinine benzoate, $C_{23}H_{19}O_5N$, having two methoxy, one N-methyl and one benzoyl groups.

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[1] Part II: D. Chakravarti, R. N. Chakravarti, L. A. Cohen, B. Dasgupta, S. Datta and H. K. Miller, *Tetrahedron* **16**, 224 (1961).

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[6] R. N. Chakravarti and S. C. Chakravarti, *Proc.* 38*th Indian Sci. Cong.* Part III, 79 (1951).

[7] R. N. Chakravarti and S. C. Chakravarti, *Proc.* 39*th Indian Sci. Cong.* Part III, 100 (1952).

[8] R. N. Chakravarti and S. C. Chakravarti, *J. and Proc. Inst. Chemists* (*India*) **24**, 96 (1952).

[9] (Mrs.) D. Chakravarti, R. N. Chakravarti and S. C. Chakravarti, *Experientia* **9**, 333 (1953).

[10] (Mrs.) D. Chakravarti, R. N. Chakravarti and S. C. Chakravarti, *J. Chem. Soc.* 3337 (1953).

[11] In spite of the strong ferric chloride coloration of arborinine[6,12] Chatterjee and Ghosh Majumdar[13] confused arborinine with skimmianine just because these are obtained from plants of the same genus and have the same m.p.

[12] R. N. Chakravarti and S. C. Chakravarti, *Science and Culture* **18**, 539 (1953).

[13] Asima Chatterjee and S. Ghosh Majumdar, *Science and Culture* **18**, 604 (1953).

[14] S. C. Pakrashi, S. K. Roy, L. F. Johnson, T. George and Carl Djerassi, *Chem. & Ind.* 464 (1961).

[15] G. K. Hughes, K. G. Neill and E. Ritchie, *Aust. J. Sci. Res.* **A 3**, 500 (1950).

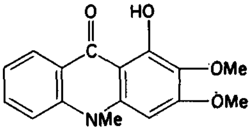
[16] G. K. Hughes and E. Ritchie, *Aust. J. Sci. Res.* **A 4**, 430 (1951).

[17] R. J. Gell, G. K. Hughes and E. Ritchie, *Aust. J. Chem.* **8**, 114 (1955).

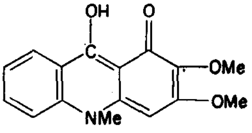
[18] Even the comparison of mixed m.p. of arborinine with the authentic specimen, kindly supplied by Dr. E. Ritchie of the University of Sydney, was carried out before the publication of the short communication by Pakrashi *et al.*[14]

On heating with concentrated hydrochloric acid, arborinine gives norarborinine, $C_{15}H_{13}O_4N$, having one methoxy and one N-methyl group. It gives a dark brown coloration with alcoholic ferric chloride. Unlike arborinine, however, it is soluble in aqueous alkali. Norarborinine yields a diacetate, $C_{19}H_{17}O_6N$, having one methoxy, one N-methyl and two acetyl groups, and a dibenzoate, $C_{29}H_{21}O_6N$, having one methoxy, one N-methyl and two benzoyl groups.

Evidently, arborinine contains a hydroxy group. The green coloration produced by arborinine with ferric chloride is not due to any oxidative change but due to salt formation, as arborinine can be recovered unchanged from the green solution. This indicates the presence of a very weakly acidic hydroxy group in arborinine although the latter is not soluble in aqueous alkali. The I.R. spectrum of arborinine is interesting in this respect. In chloroform solution it shows a very weak absorption peak between 3470 cm^{-1} (2·88 μ) and 3510 cm^{-1} (2·85 μ) (Figs. 1 and 2) which is absent in Nujol mull (Fig. 3). In view of this discrepancy, the spectrum in chloroform was determined in two different laboratories (Figs. I and II). Possibly it is not due to hydroxylic impurities in chloroform. The U.V. spectrum of arborinine was determined in ethanol but as the data are practically the same as those of Pakrashi *et al.*[14] it is not necessary to record these here. At this stage, the identical nature of arborinine and 2,3-dimethoxy-1-hydroxy-10-methylacridone (I) of Hughes *et al.*[15–17] became evident and a mixed m.p. determined with an authentic specimen[18] established their identity. It may, however, be pointed out that all the available physical and chemical data regarding this product, including those for the N.M.R. spectrum,[14] are also in agreement with the tautomeric structure (II), which, on the other hand, may be more helpful in explaining the nonreactivity of arborinine towards aqueous alkali. The position with regard to hydrogen bonding is practically the same in both these structures.



I



II

Arborinine does not appear to be an artifact as it can be isolated from the leaves of *Glycosmis arborea*, without the use of any acid, by extraction with petroleum ether (40–60°) in a Soxhlet.[8] The method used by Hughes *et al.*[17] for isolation of this product from *Evodia alata* involves use of hot 5 per cent hydrochloric acid. As under similar conditions the corresponding trimethoxy compound, which is also present in the same plant, is demethylated to arborinine[15,16] it is difficult to establish that the latter is actually a constituent of the plant, *Evodia alata*.

EXPERIMENTAL

Arborinine required for this work was obtained from the leaves of *Glycosmis arborea* as described previously.[10] The average yield is about 0·1%. Considerable seasonal variation in the yield could be observed in this case, maximum yield of arborinine being obtained in September–October, towards the end of the monsoon when the leaves are mostly young, and minimum yield in March–April from mature leaves. The position, in this respect, with regard to arborine is just the reverse. Pure arborinine has m.p. 175–176° (Found: OMe, 21·2; NMe, 9·9; C—Me, 0; Active H, 0·36. Calc. for $C_{16}H_{15}O_4N$: 2 OMe, 21·7; NMe, 10·2; 1 Active H, 0·35%).

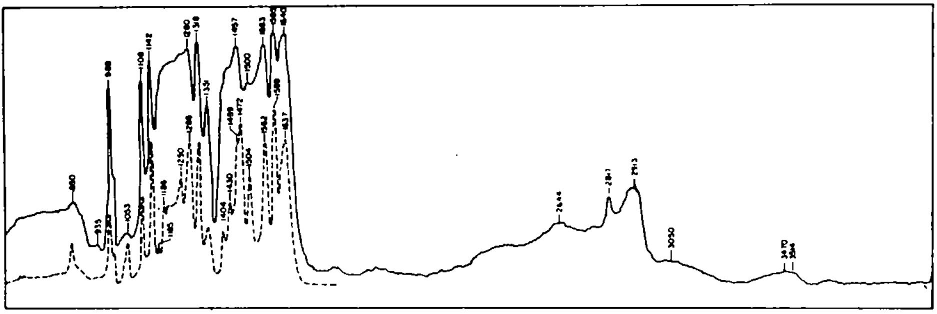


FIG. 1. I.R. Curve of arborinine in 1 % solution in chloroform, light path 1·0 mm (———) and 0·2 mm (- - - - -).

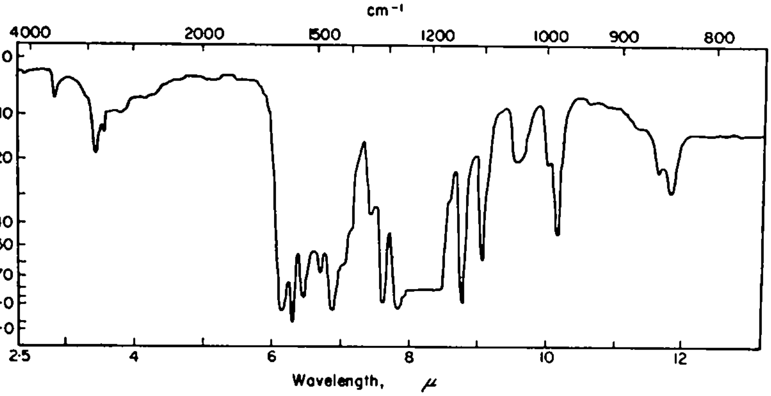


FIG. 2. I.R. Curve of arborinine in 1 % solution in chloroform, light path 0·5 mm.

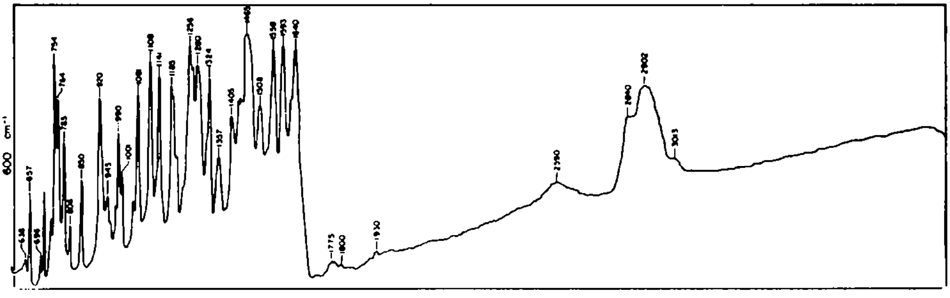


FIG. 3. I.R. Curve of arborinine as Nujol mull.

Arborinine acetate. The acetylation was carried out by refluxing arborinine (1·0 g) with acetic anhydride (5 ml) for 10 hr. On cooling, *arborinine acetate* separates out. It crystallizes from chloroform–ethanol in faint yellow (almost colourless) needles, m.p. 215–216° (Pakrashi *et al.*,[14] acetate m.p. 209–210°) (Found: C, 66·2; H, 5·3; N, 4·0; OMe, 17·5; NMe, 7·9; CH_3CO, 14·0, $C_{18}H_{17}O_5N$ requires: C, 66·0; H, 5·2; N, 4·3; 2 OMe, 18·9; NMe, 8·9; CH_3CO, 13·1 %).

Arborinine benzoate. Benzoylation of arborinine was carried out with benzoyl chloride and pyridine in the usual way. On crystallization of the product from chloroform–ethanol *arborinine benzoate* was obtained in faint yellow (almost colourless) needles, m.p. 257–258° (Found: C, 71·1; H, 4·8; N, 3·7; OMe, 14·9; NMe, 6·5; $C_{23}H_{19}O_5N$ requires: C, 70·9; H, 4·9; N, 3·6; 2 OMe, 16·0; NMe, 7·5 %).

Norarborinine. Arborinine (1·0 g) was refluxed with conc hydrochloric acid (50 ml) for 10 hr. After this period, while still hot, the clear acid liquid was decanted from a little black sticky matter and diluted with excess of water when *norarborinine* was obtained as a yellow precipitate. It was purified by crystallization from chloroform–ethanol, m.p. 242–243°, yield 0·6 g. It gives a dark brown coloration with alcoholic ferric chloride. Unlike arborinine it is soluble in aqueous alkali. Arborinine forms long canary yellow needles, whereas norarborinine is obtained in needles having a deep yellow colour (Found: C, 66·4; H, 4·9; N, 5·0; OMe, 11·0; NMe, 9·5; $C_{15}H_{13}O_4N$ requires: C, 66·4; H, 4·8; N, 5·1; OMe, 11·4; NMe, 10·7%).

Norarborinine diacetate. It was prepared similar to arborinine acetate.

Norarborinine diacetate is obtained in minute light yellow needles by crystallization from chloroform–ethanol, m.p. 240–242° with shrinkage at 238° (Found: C, 64·5; H, 4·8; N, 4·0; OMe, 9·4; NMe, 7·4; CH_3CO, 25·1; $C_{19}H_{17}O_6N$ requires: C, 64·2; H, 4·8; N, 3·9; OMe, 8·7; NMe, 8·1; 2 CH_3CO, 24·2%).

Norarborinine dibenzoate. It was prepared similar to arborinine benzoate.

Norarborinine dibenzoate is obtained in light yellow needles from chloroform–ethanol, m.p. 246–247° with shrinkage at 244° (Found: C, 72·2; H, 4·4; OMe, 6·2; NMe, 6·3; $C_{29}H_{21}O_6N$ requires: C, 72·6; H, 4·4; OMe, 6·4; NMe, 6·0%).

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