

LIMONOID EXTRACTIVES FROM THE GENERA *CAPURONIANTHUS*, *NEOBEGUEA* AND *QUIVISIANTHE*

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Abstract—A phytochemical examination has been made of three botanically isolated Madagascar Meliaceae. It is shown that *Capuronianthus* and *Neobeguea* are phytochemically related to normal members of the Swietenioideae. *Quivisianthe* is less usual, containing both oxygen heterocyclic compounds and complex and as yet unidentified limonoids. A possible relation to *Ekebergia* is suggested, but needs further investigation.

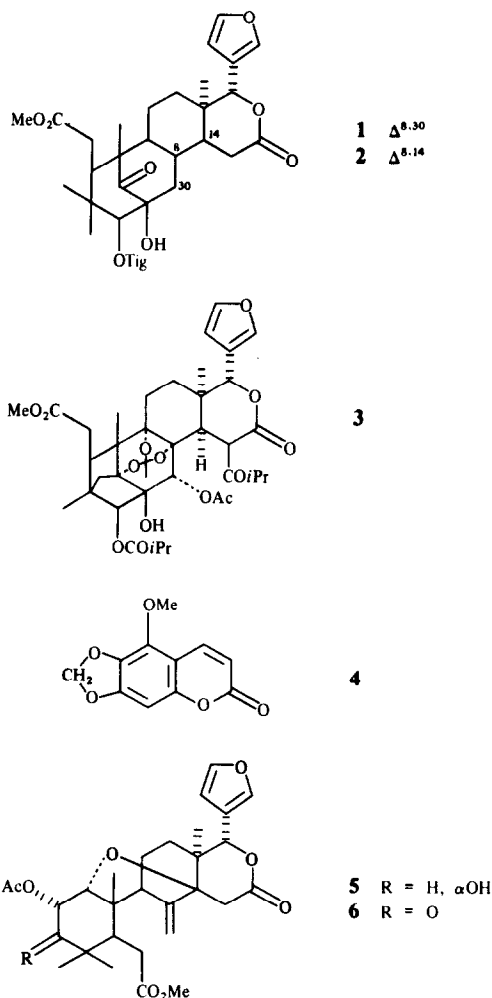
INTRODUCTION

It is well-known that the flora and fauna of Madagascar are frequently unique. In the Meliaceae, which we are studying, the endemic genera *Capuronianthus* and *Quivisianthe* are sufficiently unusual for each to be assigned to their own monospecific subfamily; while the genus *Neobeguea*, though included in the Swietenioideae, and considered as closely related to *Khaya*, has unusual features [1]. We have now been able to investigate samples of these three genera, collected in Madagascar through the co-operation of Professor Raven of the Missouri Botanical Gardens, which holds voucher specimens. In all cases, the samples consisted of stems of some five to eight cm diameter, complete with bark.

RESULTS AND DISCUSSION

Extraction of the wood of *Capuronianthus mahafalensis* gave no limonoids; the bark gave a mixture of limonoids, which were separated by chromatography. Three were obtained pure; the major one was 2-hydroxy-6-deoxyswietenine 1, identified by direct comparison with a sample from *Swietenia humilis*. [2] The second compound had a very similar ^1H NMR. spectrum, except that H-21 is considerably shifted upfield, and the resonance for H-30 is missing. This suggests that the compound is the 8,14 double bond isomer of 1, i.e. 2-hydroxy-6-deoxyswietenolide tiglate 2. This compound is not known, but the spectrum of the new compound is very similar indeed to that of 2-hydroxyfissinolide (the corresponding acetate) except for the tiglate and acetate bands, save that the resonances for H-17 and H-3 are shifted upfield in the tiglate by $\delta 0.13$, while the methyl resonances are slightly different. Similar changes are observed in the spectra of swietenolide 3-monoacetate and swietenolide 3-monotiglate; we therefore consider this compound to be 2-hydroxy-6-deoxyswietenolide tiglate. The third compound had also an extremely similar ^1H NMR. spectrum and appears to be closely related. However, without enough material for a ^{13}C NMR spectrum we were unable to identify it.

The sample of *Neobeguea mahafalensis* had been badly



attacked by herbalists for the reputedly medicinal bark; in consequence the bark remaining was extracted together with the wood. The extract readily gave in good

yield a crystalline solid, identified as pseudrelone A₂ **3**, by comparison with a authentic sample from *Pseudocedrela kotschyii* [3]. The mother liquor gave a strange compound which may, or may not, be a 17-ketolimonoid, which we have isolated before from *Entandrophragma caudatum* [4].

The *Quivisianthe papinae* sample was chemically more interesting. The timber gave no limonoids, but instead a coumarin identified by the kind assistance of Dr Francis Dean of Liverpool, as 5-methoxy-6,7-methylenedioxy-coumarin **4**.

The ¹H NMR spectrum showed the compound to be a methoxy methylenedioxy coumarin. The small coupling between H-4 and the single aromatic proton showed that the latter was H-8, and hence that the substituents were at 5,6,7. In chloroform, the methoxy group resonated at δ4.13, in benzene at δ3.65. This shift indicates an *ortho* position free adjacent to the methoxy group; if the methoxy was at C-5, with the methylenedioxy at 6,7 there would be no free *ortho* position; hence the methoxy is at C-7, and the methylenedioxy at 5-6. This is a new compound, but the related 7-(3'-methyl-2,3-oxido) butyl ether has been reported by Bohlmann [5].

The bark gave a complex and rich mixture of limonoids and oxygen heterocyclic compounds. Unfortunately, none was identified with the small amounts available to us. This incomplete report is now published because of its taxonomic interest, and because the supply situation is such that obtaining further amounts of *Quivisianthe* bark may be very difficult.

Five compounds were isolated in variable purity. The first appears to be an oxygen heterocyclic, but has not been identified even as to type. The second appears to be a very simple limonoid, but has not been identified due to the small amount of material. It is unusual in that it does not appear to contain any acyl groups, though there may be two CHOH groups present. The third is a complex limonoid. The ¹H NMR spectrum contains signals indicating a CO₂Me group and an exocyclic methylene, suggesting that the compound belongs to the ring C-open methyl angolensate group. The spectrum is in general closely similar to that of *Ekebergia pterophylla* compound **1**, methyl 2 α -acetoxy-3 α -hydroxy-3,3-dihydro-angolensate **5**, but is not identical. It is tentatively suggested that it might be the related 3-ketone **6** [6]. The fourth is a protolimonoid, since it is crystalline it should be possible to identify it, if a large enough amount is obtained for a ¹³C spectrum, while the fifth is a very strange substance with only a few ¹H NMR bands.

Capurionanthus was initially described by Leroy in 1958 [7]. He considered that it was closely related to *Carapa* and *Xylocarpus*, and included the three genera in a new sub-family, the Carapoideae. Pennington and Styles [1] consider it distinct from *Carapa* and *Xylocarpus*, and place it in its own subfamily, the Capurionanthoideae, related to but distinct from Swietenioideae and Melioideae. Phytochemically *Capurionanthus* is characterised by limonoids similar to swietenine. These occur typically in the genus *Swietenia*, and less commonly as minor components in *Khaya*.

Related compounds, however, occur throughout the Swietenioideae. There is no apparent relationship to the Melioideae. In the Swietenioideae, *Xylocarpus* characteristically contains oxides, probably derived from compounds similar to swietenine, while *Carapa* contains some simple limonoids, but is particularly remarkable for

containing highly altered and unique metabolites. Thus while *Capurionanthus* is certainly chemically at home in the Swietenioideae, it cannot be said to be particularly close to any other individual genus, except perhaps *Swietenia*.

Neobeguea was also described by Leory in 1958 [8]. It is considered to be closely related to *Khaya*. The phytochemical evidence is not entirely in accord with this since although pseudrelone A is a fairly typical limonoid of its type, with no very necessary connection to *Pseudocedrela*, the type, the 15-acyl phragmalin derivatives, is the most advanced of Swietenioideae limonoids which only occurs in the more advanced genera, *Soyimida*, *Entandrophragma*, *Pseudocedrela*, *Chukrasia* and, perhaps, *Carapa*. [9] Therefore although the relationship to Swietenioideae is undoubted, it would seem to be at a more advanced level than *Khaya*.

Quivisianthe has been known much longer. Harms [10] placed it provisionally in the genus *Trichilia*, tribe Trichilieae subfamily Melioideae. It is also considered to be similar to *Ekebergia*, in the same tribe. However Pennington and Styles [1] consider that the nature of the seed and capsule distinguishes it from all members of the Melioideae, and created a new subfamily, Quivisianthoideae in which it is the sole species. Chemically it is much the most interesting of the three specimens discussed here. The presence of a coumarin in the timber separates it at once from all other Meliaceae except *Ekebergia senegalensis*, although the *Ekebergia* coumarin, 4-methoxy-5-methylcoumarin, may not be biochemically related to coumarins lacking the 5-methyl group [11].

Taken together with the occurrence of *Ekebergia*-like limonoids in the bark, the chemical evidence does seem to suggest a relationship between the two genera, which supports the morphological evidence of affinity already mentioned. Chemically, *Ekebergia* itself is rather distinct; and not closely related to *Trichilia*; it seems possible that both *Quivisianthe* and *Ekebergia* occupy positions on the fringes of the main groups of the Meliaceae, perhaps without especially close relation to any other genera. It is certain that further chemical examination of *Quivisianthe* is required.

EXPERIMENTAL

Bark of *Capurionanthus mahafalensis* (200 g) was extracted with refluxing hexane, and the extract chromatographed in the usual way, giving 2-hydroxy-6-deoxyswietenhne (160 mg mp 210–212°); identical with an authentic sample from *S. humilis* seed [2] and trace amounts of two non-crystalline compounds.

The first of these is most probably 2-hydroxy-6-deoxyswietenolide tiglate [Found δ_H 7.46 (H-21), 7.30 (H-23), 6.85 (*br m*, tiglate) 6.47 (H-22), 5.51 (*s*, H-17); 4.85 (*s*, H-3); 4.16 (OH), 3.68 (3H, *s*, OMe), 1.16, 0.98, 0.77, 0.75 (C-Me)]. The second was not identified [Found δ_H 7.46 *m*, 7.36 *m*, 6.85 *br m*, 6.47 *m*, 5.62 *s*, 5.36 *m*, 4.85 *s*, 4.06 (*s*), 3.65 (3H *s*), 1.04, 0.96, 0.76, 0.66 (C-Me)].

Wood and bark of *Neobeguea mahafalensis* (1.5 kg) was milled and extracted with refluxing hexane. The ppt. was recrystallized from MeOH-CH₂Cl₂ giving pseudrelone A, mp 270–272° (350 mg); identical with an authentic sample. Chromatography of the mother liquor gave a non-crystalline compound previously isolated from *Entandrophragma caudatum*; (δ_H 7.98 *s*, 7.38 *s*, 6.72 *s*, 4.65 *s*, 3.64 *m*, 3.52 *s* and methyl groups). A considerable amount of this has now been obtained (250 mg) but the structure remains obscure.

In a similar way, the wood of *Quivisianthe papinae* (1 kg) gave a very small yield of a coumarin, crystallizing from methanol in colourless needles mp 198–200° (Found $\delta\text{H}(\text{CDCl}_3)$ 7.93 (1H, $J = 10$, 0.5, H-4; 6.53; 1H, $J = 0.5$, H-8; 6.06, 1H, $J = 10$, H-3; 5.99, 2H s, O-CH₂-O; 4.13, 3H, OMe; $\delta\text{H}(\text{C}_6\text{D}_6)$ 7.43, 6.27, 5.94, 5.05, 3.65).

The bark (250 g) gave a complex extract. The first fraction obtained was a yellow crystalline solid (10 mg) mp 262–265°. The ¹H NMR spectra showed complex aromatic proton bands. Of the remaining fractions, the second, which was amorphous, appeared to be a simple limonoid [δH 7.35 (2H m); 6.07 (1H m); 5.8 (1H s); 5.42 (1H, d , $J = 2.3$ Hz); 4.33 (1H m); 4.1 (1H m); 3.20 (1H s); 1.28, 1.21, 0.97, 0.89 (3H s)]. This was apparently pure; but was not identified. The fourth was crystalline compound, not pure, the spectrum was not very characteristic. The third and fifth were non-crystalline and impure.

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