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# A NEW CLASS OF QUINONES: SESQUITERPENOID QUINONES OF MANSONIA ALTISSIMA Chev.

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It is known that heartwood sawdust of Mansonia Altissima Chev., a Sterculiacea from tropical West Africa, largely used for making furniture, is the cause of several irritative symptons and heart troubles in workers engaged in this industry.

Moreover it has been described that bark extracts are used by natives for poisoning darts (I).

The presence of cardiac glycosides in such extracts was demonstrated by Uffer (2); sap and heartwood were studied by Sanderman and Dietrichs (3) who confirmed the presence of cardiac glycosides and isolated an azulenoid compound ($C_{15}H_{12}O_3$) and a quinone ($C_{15}H_{20}O_2$).

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TABLE I

| Compound | Colour | Solvent | Crude formula | M.p. |
|---|---|---|---|---|
| MANSONONE A | red | cyclohexane | $C_{15}H_{20}O_2$ | 117-8 |
| MANSONONE B | gold-yellow | hexane | $C_{15}H_{20}O_3$ | 68-9 |
| MANSONONE C | orange | hexane | $C_{15}H_{16}O_2$ | 134-8 |
| MANSONONE D | orange | cyclohexane-benzene | $C_{15}H_{14}O_3$ | 173-5 |
| MANSONONE E | orange-yellow | cyclohexane | $C_{15}H_{14}O_3$ | 148-9 |
| MANSONONE F | violet | benzene | $C_{15}H_{12}O_3$ | 214-5 |

In order to gain more information on the active principles of Mansonia and to separate the irritative from the heart active ones, the heartwood was submitted to a systematic extraction with different solvents. Pharmacological tests showed that chloroform extracts the irritative fractiones whereas ethanol extracts the heart active ones.

We shall report here the results so far obtained in investigating the chloroform fraction.

By means of column chromatography on suitable supports ($SiO_2$, $Al_2O_3$) and the use of an adequate series of solvents ($C_6H_6$, $CHCl_3$, AcOEt) six

compounds, for which we propose the name of Mansonones (Table I), have been so far obtained in pure form. The main characteristic of all the compounds is the C 15 empirical formula, a fact which suggests a possible common fundamental structure.

The second common feature is their quinonic character, as demonstrated by the easy reversible reduction under mild conditions, and confirmed by their u.v. and i.r. spectra.

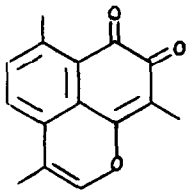
Mansonone F ( $\lambda_{max}^{EtOH}$ 234, 555 mμ) is the most dehydrogenated compound of the series and is characterized by a deep violet color. It can be considered for its reactivity towards o-phenylenediamine an ortho-quinone, and its inertness to acetylation and lack of OH absorption in i.r. demonstrate the ethereal nature of the third oxygen.

Its nmr spectrum (in $CDCl_3$ with $SiMe_4$ as internal standard; Varian A 60 instrument) readily accounts for all the hydrogens: two aromatic protons, o each to the other (AB quartet, $\delta$ 7.31, J = 8 cps); one ethylenic proton (multiplet $\delta$ 7.05, J ~ 1 cps); a strongly deshielded aromatic $CH_3$ group (singlet, $\delta$ 2.70) an allylic $CH_3$ (sharp doublet, $\delta$ 2.10, J ~ 1 cps) and a second allylic, isolated $CH_3$ (sharp singlet, $\delta$ 1.94).

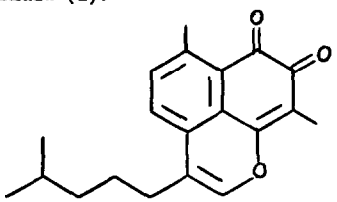
All the above evidence points to the fact that Mansonone F is a tricyclic 1,2-naphthoquinone derivative, and since the high $\delta$ value (7.05) of the ethylenic proton appearing to be in allylic coupling with the $CH_3$ group at $\delta$ 2.10 can be satisfactorily explained by the supposition of the presence of the fragment $-\overset{CH_3}{\overset{|}{C}} = CH-O-$, the third ring must contain this fragment.

Keeping in mind that two of the aromatic positions are already occupied by two protons, orto each to the other, that the high value of the aryl $CH_3$-(2.70) indicates its peri relationship to the quinone carbonyl, while one of the positions of the quinone nucleus is occupied by the isolated $CH_3$-( $\delta$ 1.94), the closure of the heterocycle in question can take place only between positions 4 and 5.

If structures violating the isoprene rule are disregarded, then Mansonone F is best represented by formula (I):



I



II

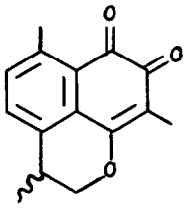
This view is strongly substantiated by the comparison with the spectra of dihydrobiflorin (II) (4).

To our knowledge, Mansonone F is the second oxaphenalene derivative found in nature and although a direct comparison was not possible, it is probably the compound $C_{15}H_{12}O_3$ to which Sandermann and Dietrichs attributed an azulenic structure (3).

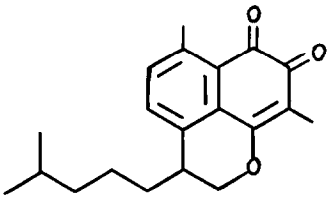
Nmr spectrum accounts very easily for the 14 protons present in Mansonone E [$\lambda_{max}^{EtOH}$ 219, 264, 370, and 445 mμ (log $\varepsilon$ 4.25, 4.31, 3.2, and 3.38)] . Two mutually orto protons are present in the aromatic region (AB quartet, $\delta$ 7.20, $J \sim 9$ cps). The presence of the group

$-\underset{\underset{CH_3}{|}}{CH}-CH_2-O-$ is argued from the two proton multiplet at $\delta$ 4.27 considered as the AB part on an ABX system, where X is the one proton multiplet at $\delta$ 3.05, evidently coupled with the aliphatic methyl doublet at $\delta$ 1.35. A methyl group peri to a carbonyl is accounted for by a singlet ( $\delta$ 2.58) and a methyl group on a quinone ring by a sharp singlet ( $\delta$ 1.89). Upon reductive acetylation, it gives a diacetate ($C_{19}H_{20}O_5$, m.p. 110°) possessing a naphtalenoid u.v. spectrum [$\lambda_{max}^{EtOH}$ 234, 307, 321, and 336 mμ (log $\varepsilon$ 4.75, 3.92, 3.86 and 3.73)]

Since after reaction with o-phenylenediamine the expected quinoxaline ($C_{21}H_{18}ON_2$, m.p. 148-150°) is obtained, it follows that Mansonone E must have the structure III:



III



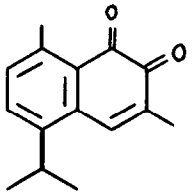
IV

A further confirmation is brought forward by the strict similarity of its spectra with those of tetrahydrobiflorin (IV) (4).

Mansonone C [$\lambda_{max}^{EtOH}$ 206, 258 and 432 mμ (log $\varepsilon$ 4.14, 4.24, and 3.39) gives with o-phenylenediamine a quinoxaline derivative ($C_{21}H_{20}N_2$, m.p. 103-4°) and by reductive acetylation a diacetate $C_{19}H_{22}O_4$, m.p. 156-8° characterized by a naphtalenoid u.v. spectrum [$\lambda_{max}^{EtOH}$ 233, 292, 304 and 324 mμ (log $\varepsilon$ 4.8, 3.87, 3.74 and 2.85)] . Nmr indicates the presence

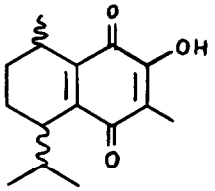
of one ethylenic proton (multiplet, $\delta$ 7.67, J ~ 1 cps); of two aromatic protons in orto to each other (AB quartet $\delta$ 7.31, J = 8 cps); of a strongly deshielded $CH_3$- on an arylic nucleus ( $\delta$ 2.62); of a $CH_3$ on a double bond showing allylic coupling ( $\delta$ 2.08, J ~ 1 cps). The one-proton multiplet at $\delta$ 3.40 and the six proton doublet at $\delta$ 1.30 both with the same coupling constant (J = 7 cps) are indicative of an isopropyl group on an aryl nucleus.

On these bases and on the assumption of a common biogenesis with Mansonone E and F, we can deduce that Mansonone C is identical with cadalene 7-8 quinone (V) synthetically prepared by Lindhal (5) as substantiated by the reported m.p. values of the substance itself and of the quinoxaline derivative:

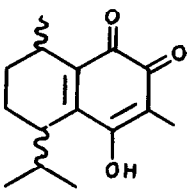


Mansonone B [$\lambda_{max}^{EtOH}$ 226, 272, and 408 mμ (log $\varepsilon$ 3.68, 3.69 and 2.4); $\lambda_{max}^{OH^-}$ 232, 283, and 525 (log $\varepsilon$ 3.7, 3.56, and 2.65)] gives a monoacetate ($C_{17}H_{22}O_4$, yellow oil b.p. 120°C at 0.02 mmHg) [$\lambda_{max}^{EtOH}$ 263, 339, and 435 mμ (log $\varepsilon$ 4.1, 2.53, and 1.8). Its nmr spectrum shows the presence of an OH proton (singlet at $\delta$ 7.11, disappearing readily on deuteration); one $CH_3$- group on the quinone nucleus (sharp singlet, $\delta$ 1.90); one secondary $CH_3$- ( $\delta$ 1.12; J = 7 cps) and one isopropyl

( $\delta$ 0.90 and 0.87, J = 7 cps). No aromatic protons, nor benzylic methylenes are present. Admitting the same skeleton to be present, to Mansonone B two alternative formulas can be attributed (VI and VII):



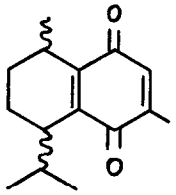
VI



VII

Also Mansonone A [$\lambda_{max}^{EtOH}$ 209 and 430 mμ (log $\varepsilon$ 4.32 and 2.93)] has no aromatic protons nor benzylic methylenes; the signal at $\delta$ 6.67 (one proton, quartet, J ~ 1 cps) and the doublet at $\delta$ 1.92 (three protons, J ~ 1 cps) can be accounted for by the system $-\overset{O}{\overset{\|}{C}}-CH = \overset{}{\underset{|}{C}}-CH_3$ as a part of a 1-4 quinone; one isopropyl group is evidentiated from a six proton doublet ( $\delta$ 1.08, J = 6.5 cps) while a doublet ( $\delta$ 0.87, J = 7 cps) indicates a secondary methyl group.

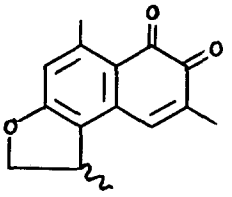
The formula proposed for Mansonone A (VIII) is in accordance with the structures of the other Mansonones and with the isoprene rule.



VIII

This quinone is probably, owing to the coincidence of data, identical to that described by Sandermann and Dietrichs (3).

Mansonone D [$\lambda_{max}^{EtOH}$ 219, 243, 278 and 405 mμ (log ε 4.3, 4.1, 4.11, 3.88)] does not give an acetate; it reacts with o-phenylenediamine to give a quinoxaline; we propose for it the tentative structure (IX):



IX

which reasonably accounts for the observed nmr signals: a somewhat shielded hydrogen in pos. 4 of a 1,2-quinone system (quartet, $\delta$ 7.22, J ~ 1 cps); one shielded aromatic proton (singlet, broadened by benzylic coupling, $\delta$ 6.60); two hydrogens on an oxygen bearing carbon (AB part of an ABX system, $\delta$ 4.52); a benzylic hydrogen (X part of the above ABX system showing ulterior coupling ($\delta$ 3.58); a deshielded aromatic $CH_3$-($\delta$ 2.65, singlet, slightly broadened); an allylic $CH_3$-($\delta$ 2.06, sharp doublet, J ~ 1 cps); a secondary methyl ($\delta$ 1.38, doublet, J = 7 cps).

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