

REACTIONS OF ARYLTETRALIN LIGNANS WITH DDQ - AN EXAMPLE OF DDQ

OXIDATION OF AN ALLYLIC ETHER GROUP.

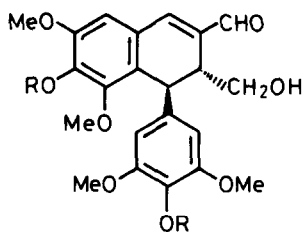
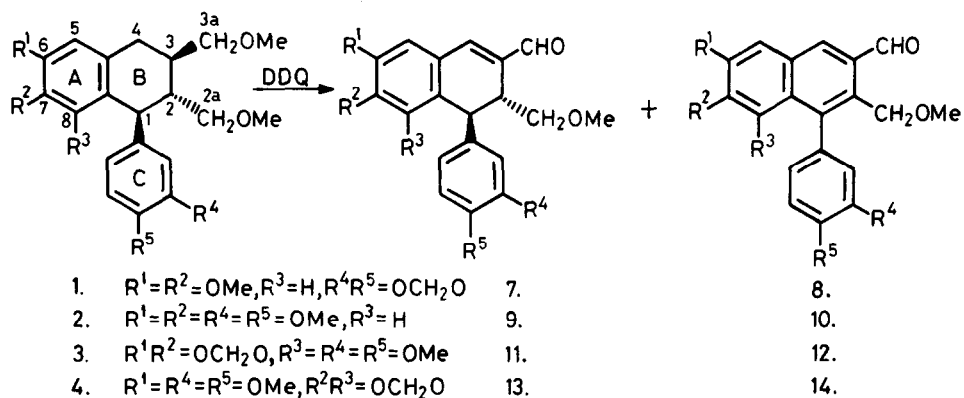
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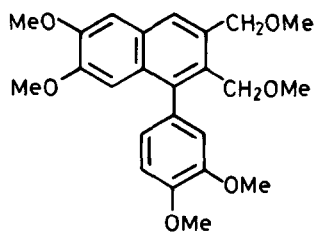
Summary. The reactions of lintetralin, phyltetralin, nirtetralin and hypophyllanthin with DDQ yield in each case two products which have been identified as an aryl-naphthalene aldehyde and its dihydro derivative.

The structures of the four aryltetralin lignans from *Phyllanthus niruri*¹⁻⁶ have been finally established by synthesis.^{7,8} While lintetralin (1) and phyltetralin (2) are disubstituted in ring A, nirtetralin (3) and hypophyllanthin (4) are both trisubstituted in ring A and indeed are isomeric. As part of our investigation of the structural characteristics of these compounds⁵ we have now studied their reactions with 2,3-dichloro-5,6-dicyano-1,4-benzoquinone (DDQ) in benzene.

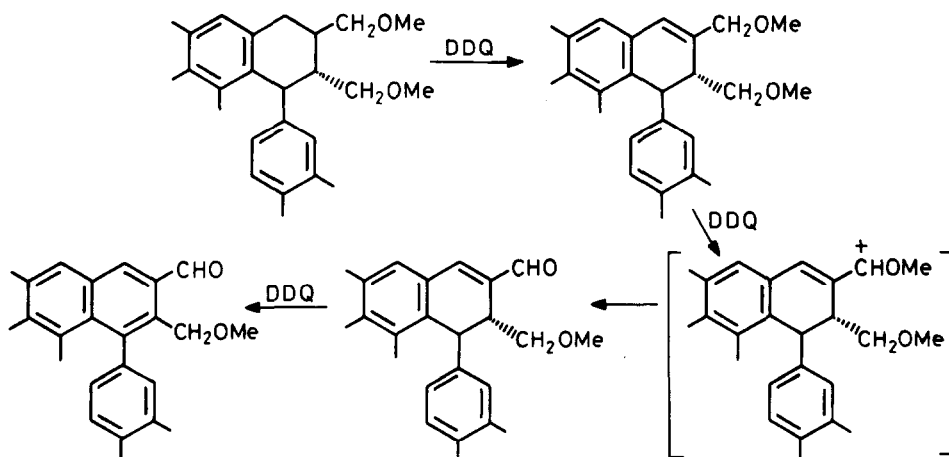
On treatment with three equivalents of DDQ in benzene in each case two products were obtained. Thus, for example, when hypophyllanthin (4) was treated with DDQ in benzene under reflux for 24 hours two products were formed which could be separated by thin layer chromatography. The slower running component (R_f 0.18, benzene-EtOAc, 7:2) had molecular formula $C_{23}H_{24}O_7$ and showed bands at 1670 cm^{-1} in its infrared spectrum, and at 235(3.40) and 345(3.26)nm in its u.v. spectrum. The faster running component (R_f 0.25, benzene-EtOAc, 7:2) had molecular formula $C_{23}H_{22}O_7$ and showed an infrared band at 1670 cm^{-1} , and u.v. bands at 233(4.30), 260(4.02), 280(4.02) and 340(3.70)nm. The latter compound also gave a deep red 2,4-DNP derivative, m.p. 262° . The u.v. spectra closely resembled those of collinusin⁹ and justicidin B⁹ and suggested that the compounds are a dihydro-arylnaphthalene and an aryl-naphthalene respectively. The ^1H n.m.r. spectra (Table 1) showed clearly the presence of an aldehyde group in both compounds and further indicated that one of the high field aliphatic methoxyl groups had been removed. Complete analysis of the ^1H n.m.r. spectrum of the slower running component and comparison with the spectra of the known compounds (5) and (6)^{9,10} lead to structure (13) for this compound. Further consideration of the spectra of the other product and comparison with known aryl-naphthalenes¹¹ and with synthetic dehydrophyltetralin (15)¹² similarly lead to structure (14) for the faster running component. Similar products (7-12) were also obtained from each of the other three aryltetralins.



5. $R=Me$
 6. $R=CH_2Ph$



15.



Scheme 1.

Not surprisingly therefore the four lignans are reacting in an identical manner with DDQ under these conditions and a possible mechanism accounting for the formation of the observed products is shown in Scheme 1. The first step is thought to involve hydride abstraction from C-4 rather than C-1 presumably due to the greater crowding at the latter position. Subsequent oxidation of the allylic ether group leads to the generation of an aldehyde group at C-3.

Table 1. ^1H n.m.r. and mass spectra.

	<u>7</u>	<u>8</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>14</u>	<u>15</u>
H-1	4.37br.s	-	-	4.65br.s	-	4.50br.s	-	-
H-2	3.0-3.5m	-	-	3.0-3.5m	-	3.0.3.5m	-	4.26s
H-2a		4.56s	4.62AB		4.44AB		4.51m	4.44s
H-4	7.34s	8.28s	8.37s	7.18s	8.22s	7.26s	8.30s	7.70s
arom	6.45m	6.7-7.0m	6.8-7.1m	6.35dd	6.7-6.9m	6.45dd	6.7-6.9m	6.7-7.2m
	6.6-6.9m	7.22s	7.31s	6.60m	7.05s	6.70m	7.06s	-
CHO	9.56s	10.38s	10.45s	9.50s	10.36s	9.53s	10.36s	-
OCH ₂ O	5.89s	6.05br.s	-	5.94s	6.03s	6.01m	5.82br.s	-
OMe	3.40s	3.24s	3.32s	3.32s	3.21s	3.38s	3.25s	3.20s
	3.89s	3.73s	3.78s	3.74s(x3)	3.35s	3.79s(x2)	3.82s	3.44s
	3.96s	3.97s	3.90s		3.84s	3.94s	3.94s	3.64s
			4.03s		3.94s		3.99s	3.80s
		4.05s						3.92s(x2)
m/e	382(41)	380(28)	396(28)	412(64)	410(22)	412(53)	410(31)	412(51)
	337(100)	348(100)	364(100)	367(47)	378(100)	367(100)	378(100)	380(19)
	309(75)			339(100)		339(33)		365(21)
				308(35)		309(33)		349(100)

* ^1H n.m.r. spectra run in CDCl_3 solution.

Finally the appearance of the CH₂ group (H-2a) in the spectra of the aryl-naphthalenes (10) and (12) as an AB system deserves further comment, since it implies that the two hydrogen atoms must be nonequivalent. Since there is no other source of asymmetry present in the molecule this presumably indicates that there is restricted rotation about the biaryl linkage giving rise to enantiomeric structures and making the two hydrogen atoms of the CH₂ group diastereotopic. To our knowledge this is the first case in which specific evidence for atropisomerism has been observed in aryl-naphthalene lignans and the first example of DDQ oxidation of an allylic ether group.

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